American Machinist

APRIL 24, 1935

A Measure of Fitness

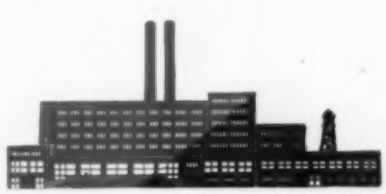
THIS 1935 INVENTORY of Metal-Working Machinery is presented to the metal-working industry by *American Machinist* as a means by which it can evaluate itself. Statistical agencies give the volume and value of the products manufactured, the number of plants in operation, the number of men in these plants and various other indications of productive performance. But the picture of physical plant facilities, as presented in the following pages, is not obtainable elsewhere.

The present study forms the third of a quinquennial series. It is of greater value than its predecessors, made in 1925 and 1930, because by comparison with them it gives more than a static picture of metal working in the United States. By means of this comparison, it is possible to trace the state of physical equipment from the post-war period, through the predepression years and to round out the picture by a presentation of the status after half a decade of subnormal business.

In offering this inventory, we are returning to the metal-working industry something which belongs to it, since it took so large a part in the preparation. We were aided greatly by the Durable Goods Industries Committee, of which George H. Houston is chairman, and in particular by Franklin R. Hoadley and George P. Torrence, members of the Sub-Committee on *American Machinist's* Questionnaire. We are also indebted to the executive officers of more than a hundred Code Authorities for help in building our mailing list.

We wish to acknowledge the assistance rendered by LeVerne Beales, director of the Census of Manufactures; Virgil Jordan, president, National Industrial Conference Board; R. E. W. Harrison, chief, Machinery and Agricultural Implements Division, Department of Commerce; and by the Machinery & Allied Products Institute. And we express our gratitude to the hundreds of shop executives and financial officials who spent many hours of their valuable time filling out the rather formidable questionnaire which forms the basis of this study.

If the facts and figures which follow enable the metal-working industry to appraise itself, to take stock of its present facilities and so wisely to lay plans for constructive action, we shall feel amply repaid for their compilation.



65%

ACCORDING to *American Machinist's* 1935 Inventory, 65 per cent of this country's metal-working equipment is now over ten years old. In 1925 the corresponding figure was 44 per cent, and in 1930 it was 48 per cent. Only major items of machine tools, presses, forging machines and welding equipment are included in the 65 per cent figure. Plant service and miscellaneous equipment and foundry equipment are reported separately with 52 and 58 per cent respectively over ten years old. In 1930, plant service and miscellaneous equipment was found to be 39 per cent old while only 36 per cent of the foundry equipment had passed the ten-year mark. These two classifications were not reported in 1925. In the supplement to this number, figures for all classes of equipment are given in detail.

Modern equipment, as shown by this survey, is playing a relatively smaller part in metal-working than it did a decade ago. Obviously this condition was caused by the low state of business activity during the past five years which acted as a brake on industrial buying. Plants with excess equipment and those operating on a short work week preferred not to expend their cash reserves when faced with a depression of indeterminate duration. This policy persisted even when plant facilities were woefully out of date and a current saving through the use of improved facilities was clearly obtainable.

The first *American Machinist* inventory considered old machinery as that bought prior to January 1, 1915. It included as new all the equipment bought during the war years regardless of its utility in post-war manufacture. Many of these machines were designed primarily to make munitions, and many others were sub-standard because of the rushed conditions of their manufacture. The slump in trade during 1921-22 offset to some degree the war-time peak of buying but not sufficiently to make the 1925 report show a lower percentage of old equipment than those which followed.

Five years later, the biggest boom period in the country's history had just passed; much of the war equipment had been liquidated, and most

OVER 10 YEARS OLD

A steadily growing percentage of obsolete equipment accounts for much of the red ink on the books of our metal-working plants

of the stronger firms had a comfortable cash surplus. The 1930 inventory overlapped that for 1925 in that equipment bought in 1920-1924 inclusive was classed as new for both. From the higher percentage of old equipment reported in 1930 it is apparent that even boom years of 1925-29 did not equal the war period in rate of plant equipment replacement.

The present report also classes equipment purchased in the boom years as new but includes, in addition, the succeeding five years of curtailed buying. It indicates that, at present, industry is more poorly equipped to manufacture metal products than at any time since the start of the World War.

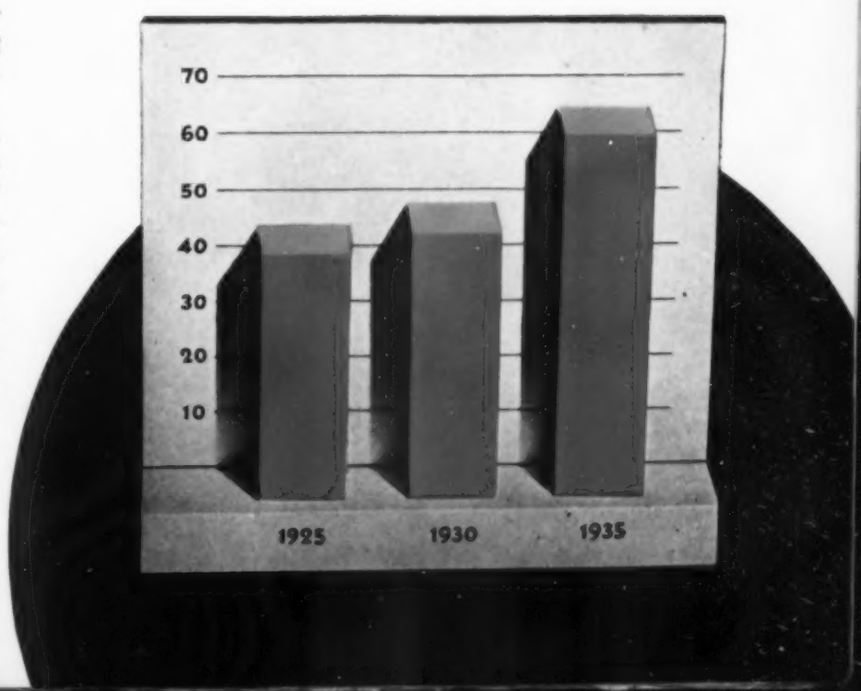
This is surely contrary to the statements of those who contend that over-mechanization is the chief cause of this country's economic straits. A more likely conclusion is that our low state of business is caused by a lack of adequate production facilities.

To restore our standard of living and to elevate it above old levels it is just as important to decrease manufacturing costs as it is to increase wages. Governmental agencies have made strenuous efforts toward higher wages but have cancelled any gains made in this direction by creating uncertainties which have discouraged the installation of modern equipment.

Machinery purchases depend upon investment, and investment depends upon opportunity to take attractive risks. Legislation and threats of legislation aimed at a curtailment of profits or freedom of action in business reduce the incentive to take such risks. The basic economic hazards that dried up investment during the downswing following 1929 seem to have largely disappeared. Now, the artificial stumbling blocks created in legislative halls stand in the way.

The picture presented in the following pages is one of deferred spending for industrial needs. It shows industry ill prepared to meet the pressure of new demands. Upon studying these figures it must become evident that this condition cannot continue; the economic need for new plant equipment is too pressing to be ignored much longer. Funds are not lacking, for financial institutions fairly burst with idle credit facilities striving to find productive occupation.

Government efforts to raise prices have had little effect on industrial goods as yet. But indications are that prices will rise, that interest rates will increase and that demands for heavy equipment will become urgent. The manufacturer in the best position will be the man who anticipates these trends by putting his plant in excellent physical condition now. He will take full advantage of current favorable conditions for modernization and install the best equipment obtainable to meet a rising demand.



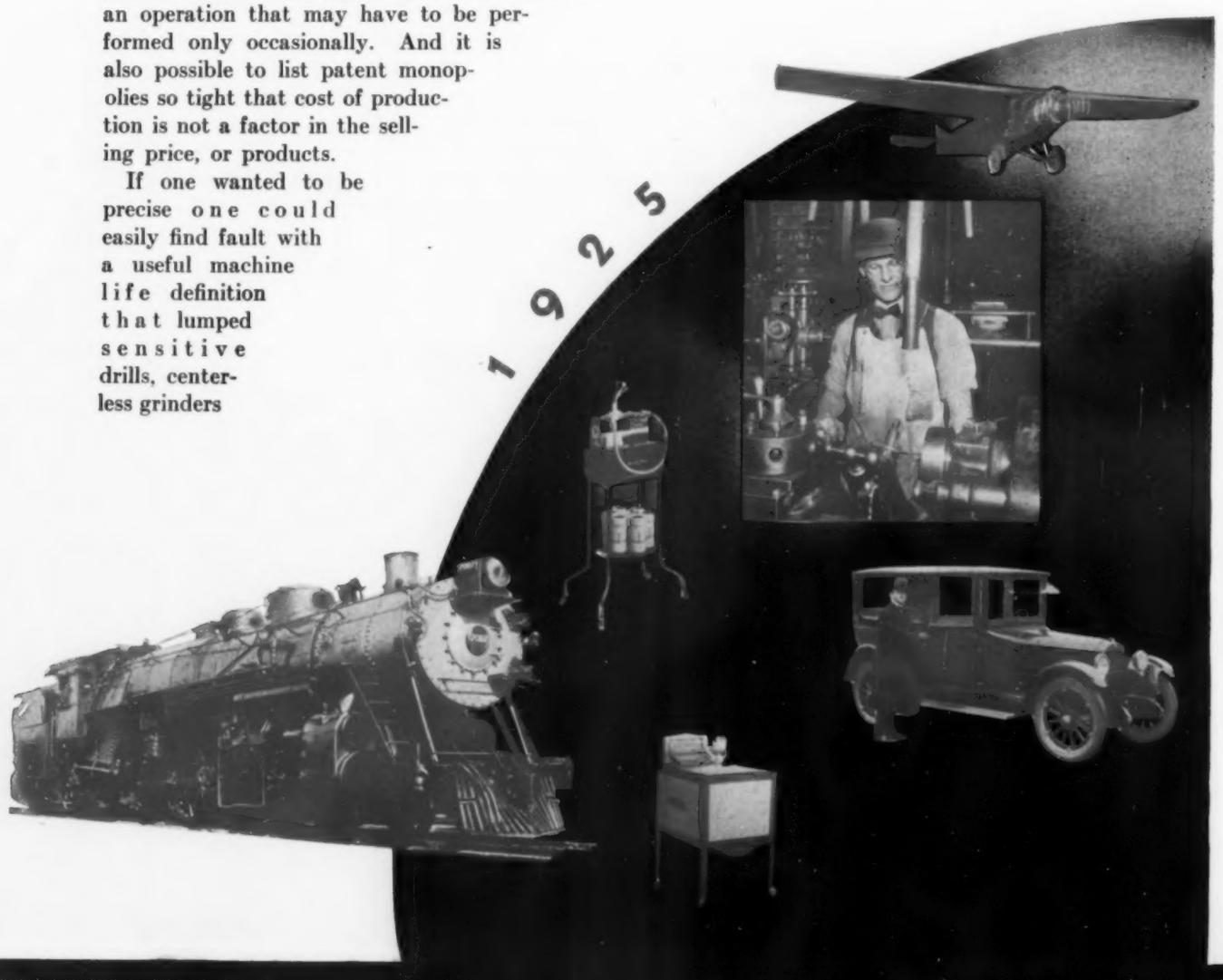
Why a Ten-Year Life?

SO MANY factors enter into the question of what makes a piece of metal-working machinery obsolete that the establishment of an arbitrary life limit, beyond which all machines are no longer effective, is a difficult task. It is our belief that after ten years the average machine tool can be replaced to advantage in any shop where reasonable standards of accuracy are demanded; where the machine is used an appreciable part of the time; and where production at a minimum of expense is required.

Anyone can think of plenty of exceptions to this general case. For instance, if the accuracy of the finished part is not important it may be possible to use to advantage a machine that has not now, and never had, built into it the precision that is prerequisite to accurate metal cutting. Likewise, there are situations where a particular machine is indispensable to take care of an operation that may have to be performed only occasionally. And it is also possible to list patent monopolies so tight that cost of production is not a factor in the selling price, or products.

If one wanted to be precise one could easily find fault with a useful machine life definition that lumped sensitive drills, centerless grinders and boring mills. Obviously the larger machines are more likely to have a long life than the smaller ones are. They represent a much heavier capital investment and for that reason, if for no other, they are less likely to be replaced frequently by the user, or redesigned very often by the builder. They operate at lower speeds and are less subject to deterioration from wear and vibration.

But for practical purposes a survey like this one would fall of its own weight if it attempted to be too precise and in so doing introduced into the questionnaire a mass of complication so forbidding that no one in his senses would attempt to answer it. Furthermore, the task of analyzing data based on different standards of machine life would be quite beyond the bounds of practicability. For these reasons it becomes essential to



adopt an arbitrary useful life period based rather on obsolescence of design than on physical deterioration.

This decision was made ten years ago when *American Machinist* made its first study of equipment obsolescence as a basis for the various modernization campaigns that have been carried on since that time. Admitting that the ten-year life theory does not apply equally to all types of machines, nor to all types of plants, the fact remains that the companies which have adopted a policy of replacing approximately ten per cent of their equipment each year are among the most successful and profitable enterprises in our industry.

But what evidence is there that design has maintained a pace that warrants our assumption that the average machine is obsolete after ten years? One way to secure this evidence is to go back over the Shop Equipment Review Numbers of *American Machinist* that have appeared during the past decade. We find that in that period more than 2,400 new power-driven machine tools were described, and that the total sum of all types of shop equipment was close to 6,300. We find also that every known type of machine tool has been thoroughly redesigned, some of them several times, since 1925, and are therefore convinced that the assumption is correct.

To check our own ideas on this subject we asked the machine tool builders to tell us what changes had been made in their respective products in the last ten years. Briefly, these changes can be summarized under four heads: (1) greater productivity—in some cases more than ten times as much material can be removed in a given time; (2) greater accuracy—machines designed and built ten years ago are totally incapable of working to the close limits now demanded by many customers; (3) better materials—alloy steels and irons for machine parts, greatly improved heat-treatments, the application of many new kinds of cutting tools, including the hard carbides, have revolutionized design and performance; (4) incorporation of hydraulic and electric controls, ball and roller bearings, better plain bearings, automatic lubrication systems, new types of drives, and many other similar improvements have made the machine tool of 1935 an entirely different and immensely superior unit from its ancestor of 1925. Corresponding advances in the methods of forming, grinding and welding metals have kept the machines used for these processes well abreast of the design improvements in machine tools of the cutting type.

One has but to compare the progress in the products of the machine tool to realize the advance in the art of metal working in the past decade. Since these products can be no better than the tools that make them it seems hardly necessary to offer further proof that ten-year old shop equipment is obsolete.

How Much

Expenditures for Metal-Working Equipment By Industrial Divisions

Industrial Divisions	Expenditures 1920-1924	1925-1929	1930-1934
1. Agricultural Implements	0.6	2.1	1.6
2. Motor Vehicles	7.1	11.3	7.3
3. Aircraft, Engines and Parts	0.4	0.4	1.7
4. Motor Vehicle Bodies and Parts	16.0	21.0	20.6
5. Construction, Mining and Oil-Well	1.9	1.2	1.2
6. Conveying and Transmission	0.7	1.3	0.8
7. Industrial Electrical Equipment	10.3	12.0	11.3
8. Domestic Electrical Appliances	0.4	0.8	0.6
9. Fabricated Metal Products	26.3	22.1	33.5
10. Engines, Turbines and Waterwheels	1.9	1.3	0.8
11. Foundry Products	2.3	1.8	2.3
12. Food Machinery	0.9	0.4	0.7
13. Machinery Not Otherwise Classified	9.6	7.5	4.7
14. Printing, Pulp and Paper Machinery	0.5	0.5	0.3
15. Metal-Working Machinery	2.2	3.4	2.4
16. Pumps, Fans and Compressors	0.8	0.9	0.8
17. Office Equipment	3.3	2.8	3.0
18. Special Tools, Dies and Machines	1.5	1.2	0.9
19. Railroad Equipment and Repairs	12.5	7.6	4.9
20. Textile Machinery and Parts	0.6	0.4	0.6
Total for all Divisions	82.1	100.0	42.6

1925-1929 = 100

THE QUESTIONNAIRES sent out for the 1935 Inventory of Metal-Working Equipment contained one set of questions not used in 1925 or 1930. Each plant was asked to state its expenditures for equipment during three five-year periods: 1920-1924, 1925-1929 and 1930-1934, inclusive in each instance.

Not all the concerns supplying data on their shop equipment gave the amount of their expenditures. Consequently, the conclusions derived from this portion of the survey are less accurate than those for the machines in place. It has not been considered advisable to derive an absolute dollar value of these expenditures, but after weighing each industry for its relative importance as regards return of questionnaires a series of percentages has been set up.

For readers interested in dollar value, it is suggested that the value of products of the machine tool industry for the years 1925, 1927 and 1929 be used as a basis for the second five-year period. By interpolating for the years 1926 and 1928, taking into consideration the average index of machine tool orders for these years, a total of $910,000,000 is determined as the value of products for 1925-1929. This includes replacement and repair parts, and receipts for contract and repair work. Machine tools proper, including those made as secondary products of other industries, would amount to abount 75 per cent of this figure, or approximately $682,500,000.

From this as a basis the percentage of expenditures, as obtained from this survey, may be applied. For over-all values the dollars spent during 1920-1924 were 82.1 per cent of those for 1925-1929; for the years 1930-1934, expenditures were 42.6 per cent of 1925-1929.

On the facing page three stacks of money are shown which represent by their height the money expended on new equipment for the three five-year periods. In addition to its purpose in indicating the trend of industrial buying as a whole, each stack is divided into twenty parts to represent the twenty industrial markets upon which the survey is based.

Buying is thus shown by industrial classifications as well as in total. In this way, the graphical presentation gives the trend of each of these markets and its relative importance.

For example, the industrial division designated as manufacturers of aircraft, engines and parts has increased in importance as a market for metal-working equipment during the period covered by the survey. In 1920-1924 this industrial group accounted for only 0.4 per cent of the total, in 1925-1929 the percentage was unchanged, but in 1930-1934, it rose to 1.7.

Railroads, on the other hand, typify a diminishing market. Percentages of total metal-working equipment expenditures for this group were 12.5, 7.6 and 4.9 respectively for the three five-year periods. Other markets which have declined in relative importance are construction, mining and oil-well equipment plants (1.9, 1.2 and 1.2 per cent); printing, paper and pulp machinery makers (0.5, 0.5 and 0.3 per cent); special tool, die and machine shops (1.5, 1.2 and 0.9 per cent) and plants making machinery not otherwise classified (9.6, 7.5 and 4.7 per cent).

Some industrial divisions showed comparatively little variation in their relative standing as equipment buyers. Among these are manufacturers of industrial electrical equipment (10.3, 12.0 and 11.3 per cent); textile machinery builders (0.6, 0.4 and 0.6 per cent); office equipment manufacturers (3.3, 2.8 and 3.0 per cent), and makers of

for New Equipment?

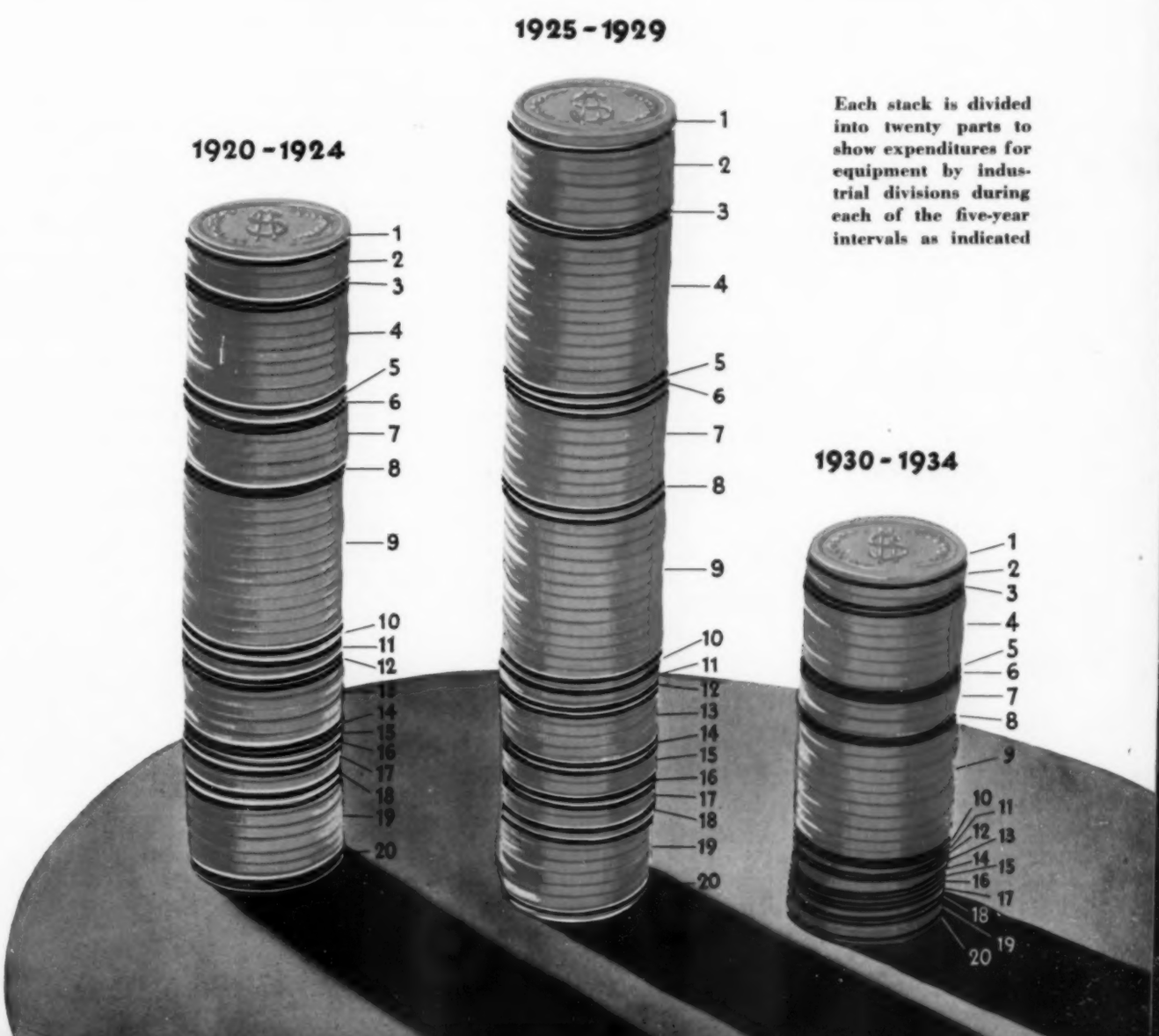
pumps, fans and compressors (0.8, 0.8 and 0.8).

It should be borne in mind that these percentages are entirely relative values. For instance, the fabricated metal products group, although spending a greater percentage of the total during the depression years, did not increase its expenditures in actual dollars. As a matter of fact, its purchases fell off by about a third. This, however, was a better-than-average showing which added to the importance of this industrial division in the general picture.

The graphical presentation takes care of both relative and total expenditures. Vertical dimensions in the stack are proportional to dollar outlay during three five-year periods. An industrial division may show a smaller total expenditure in 1930-1934 than in the preceding period and still constitute a larger share of the total.

These figures clearly indicate that certain industrial groups have fallen behind in maintaining their plant equipment. This fact is important to production executives in these industries as it uncovers a weakness which must be corrected if the plants concerned are to maintain their competitive position.

Another use for these studies is in pointing out the trends of markets for metal-working equipment. Because of year-to-year changes in consumer demand there will always be a shift from one type of manufacture to another. The result is a constantly varying market for metal-working tools as indicated by the figures on these pages.


1925 - 1929
1920 - 1924
1930 - 1934
Each stack is divided into twenty parts to show expenditures for equipment by industrial divisions during each of the five-year intervals as indicated

The Answer

MODERNIZATION

SINCE this survey shows the inadequacy of our present plant facilities in the highly important field of metal-working, the question arises, "What shall we do about it?" What must industry plan in order to rehabilitate itself and lay a basis for restoring and exceeding former living standards? The economist who takes a broad view of this problem must conclude that a good standard depends on abundance rather than scarcity and that abundance requires a firm foundation in efficient industry.

The remedy for our present critical condition is, of course, to modernize by weeding out uneconomic equipment and replacing it with tools of improved design. Superficially this program seems simple enough, but closer study discloses that it will require a determined and persistent effort.

The chart shown traces fluctuations in the index of machine tool orders as compiled by the Supervisory Agency for that industry. The black portion represents the level of the three months' moving average of orders, plotted on the center month, from 1919 to the present on the basis of average monthly shipments during 1926. It forms a graphic picture of the wide swings in activity in this industry.

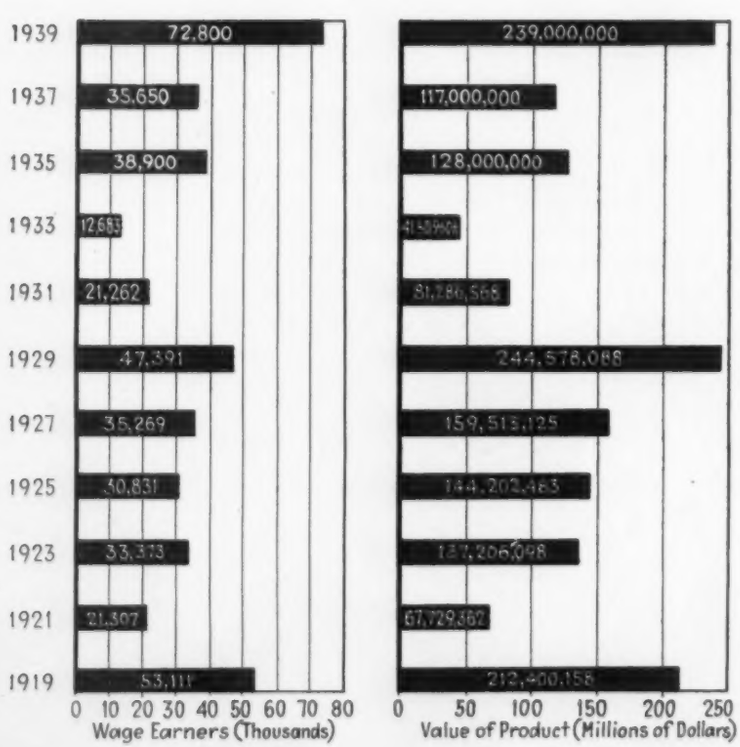
In the blue portion the chart has been extended through 1939. This extension is not intended to be a prophecy, for the foolhardiness of projecting any curve five years into the future is fully appreciated. It is, however, designed to show what the metal-working industry must do to maintain even its present low rate of efficiency.

Since only a pessimist would assume that industry will not better its present status of 65 per cent of old equipment, the blue line is a pessimistic indicator of the trend of orders.

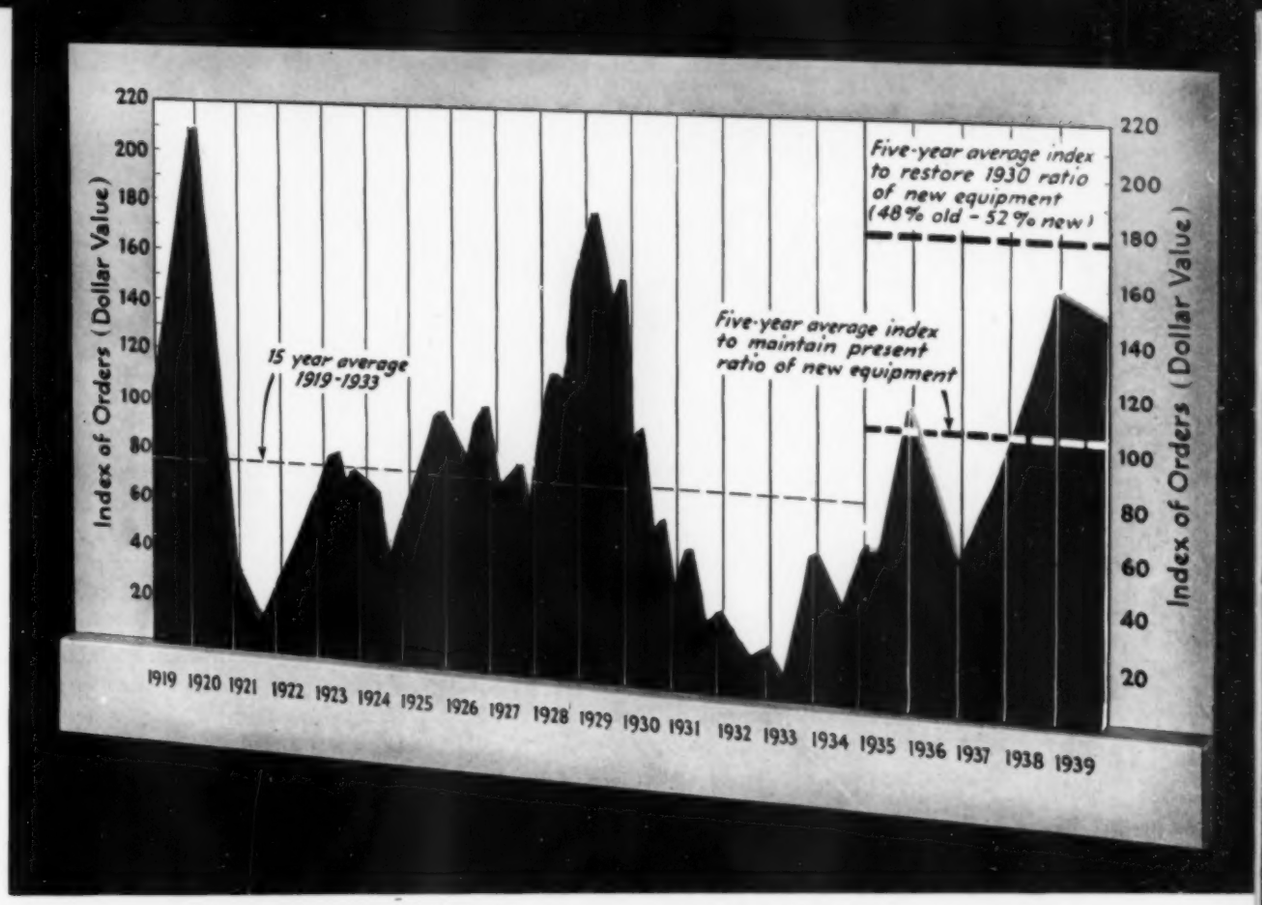
The basis for the extended curve is simple. By the end of 1935 all equipment produced during 1925 will be over the ten-year mark. So if we are to maintain our present percentage of modern equipment we must replace during 1935 an amount of machinery equivalent to that installed in 1925. To make this effective 1935 machine tool production should equal that for 1925, neglecting the lag between placing the order and actual installation of a machine.

Similarly, output during the years 1936 to 1939 should approximate that during 1926 to 1929 respectively, if at the end of each year the industry is to keep its percentage of equipment over ten years old down to 65 per cent.

The bar charts show the wage earners employed and the value of product in the machine tool industry from 1919 to 1933 inclusive. These also have been extended to 1939 in proportion to the machine tool indexes estimated above. They show an increase in wage earners from 12,683, according to the last census figures, to 72,800 in 1939. The corresponding increase in value of product would be from $41,509,608 in 1933, as



In 1927 and preceding years manufacturers of machine tool accessories and machinists' precision tools were classed by the Census of Manufactures under machine tools, foundry and machine shop products or cutlery and edge tools. In 1929 and the following years, a separate classification was set up for machine tool accessories and machinists' precision tools, reducing the machine tool classification so the figures are not exactly comparable to those for previous years.


Index of Orders (Dollar Value)
220
200
180
160
140
120
100
80
60
40
20
15 year average 1919-1933
Five-year average index to maintain present ratio of new equipment
Five-year average index to restore 1930 ratio of new equipment (48% old - 52% new)
1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939

Note: From 1919 to 1933, inclusive, the curve represents the index of machine tool orders compiled by the National Machine Tool Builder's Association. From January 1934 to date, orders for forging machinery are included. Average monthly shipments of 1926 = 100%. The three months' moving average is plotted on the center month

indicated in the census, to $239,000,000 in 1939.

The total indicated expenditure would be $822,500,000. It is interesting to note in this connection that a survey conducted by the Machinery and Allied Products Institute gives a pent-up demand for machine tools of $724,410,648.

The table on this page shows what this means in terms of machines. In order to maintain the present ratio of old to new equipment 336,745 major metal-working machines will be needed before 1940. To improve the ratio and restore it to the level of 1930, 563,800 machines will have to be replaced in the next five years. This does not include foundry equipment, plant service equipment, machine accessories and attachments.

Again it is emphasized that these figures are not predictions. They merely indicate the minimum replacement that must be done to maintain our present status as regards obsolescence.

Machines in place, Jan. 1, 1935	1,345,447
Machines over 10 years old on Jan. 1, 1935	879,522
Machines in place 10 years old or less	465,945
New machines installed since 1929	129,200
New machines needed in the next five years to maintain 65-35 ratio	336,745
New machines needed in the next five years to restore 48-52 ratio	563,800
Machine tool index to maintain 65-35 ratio	107.3
Machine tool index to restore 48-52 ratio	179

A more optimistic view would be that the metal-working industry would undertake to do better than this and recover the ground lost during the depression. The figure of 48 per cent old equipment, reached in 1930, was considered a poor showing for a country after five prosperous years. Surely a return to this figure by 1940 would not be too high an objective. But in order to accomplish that industry would have to absorb new machines at an index rate of 179 or a level approximating the peak reached in 1929.

To start in motion the buying needed for such modernization requires courage and confidence. However, from the facts given in this survey the necessity for such action is obvious. Otherwise we face an extended period of industrial inefficiency that will make for high manufacturing costs, create a wide spread between raw material prices and prices to the consumer, reduce purchasing power and further depress the standard of living.

The 20 Major Markets

FOR PURPOSES of industrial classification, twenty kinds of plants, all users of metal-working equipment, are the basis of this survey. The 1925 inventory was broken down into sixteen such divisions and the 1930 inventory into twenty.

In general, the current survey uses the same classifications employed in 1930, but the few differences should be pointed out. "Wood-working machinery", which showed a total of only 5,142 machines in the 1930 survey, was grouped with "machinery, not otherwise classified" in the present report. "Hydraulic, mining and oil well" and "construction equipment" were reported separately five years ago but have been combined into "construction, mining and oil well." Also, "iron and steel products, other than machinery" and "non-ferrous metal products", shown in two separate divisions in the previous survey, are now combined into "fabricated metal products" to correspond to the grouping covered by the Fabricated Metal Products Federation.

Since twenty industrial groups were used both in 1930 and 1935 the one omission and two combinations, noted above, left room for three new divisions. One of these is "domestic electrical appliances", which has been separated from "industrial electrical equipment", whereas five years ago one classification served for both. In 1930, "metal-working machinery", a group which comprises chiefly machine tool builders, was not reported, but now it appears as a separate classification. The general group "job shops and miscellaneous machinery" of 1930 has been divided into "machinery, not otherwise classified" and "special tools, dies and machines". This is to distinguish between plants primarily devoted to toolmaking and jobbing, and those making standard lines of machines not of sufficient volume to report separately.

In considering volume and percentage of equipment all through this survey it should be borne in mind that only metal-working equipment is referred to. For example, when 72 per cent of equipment over ten years old is given for "textile machinery and parts", the percentage applies to the metal-working facilities of plants making textile machinery. In the past there has been some confusion on this score by readers who assumed that the survey covered equipment other than metal-working machinery and that the percentage in this case referred to textile machinery.

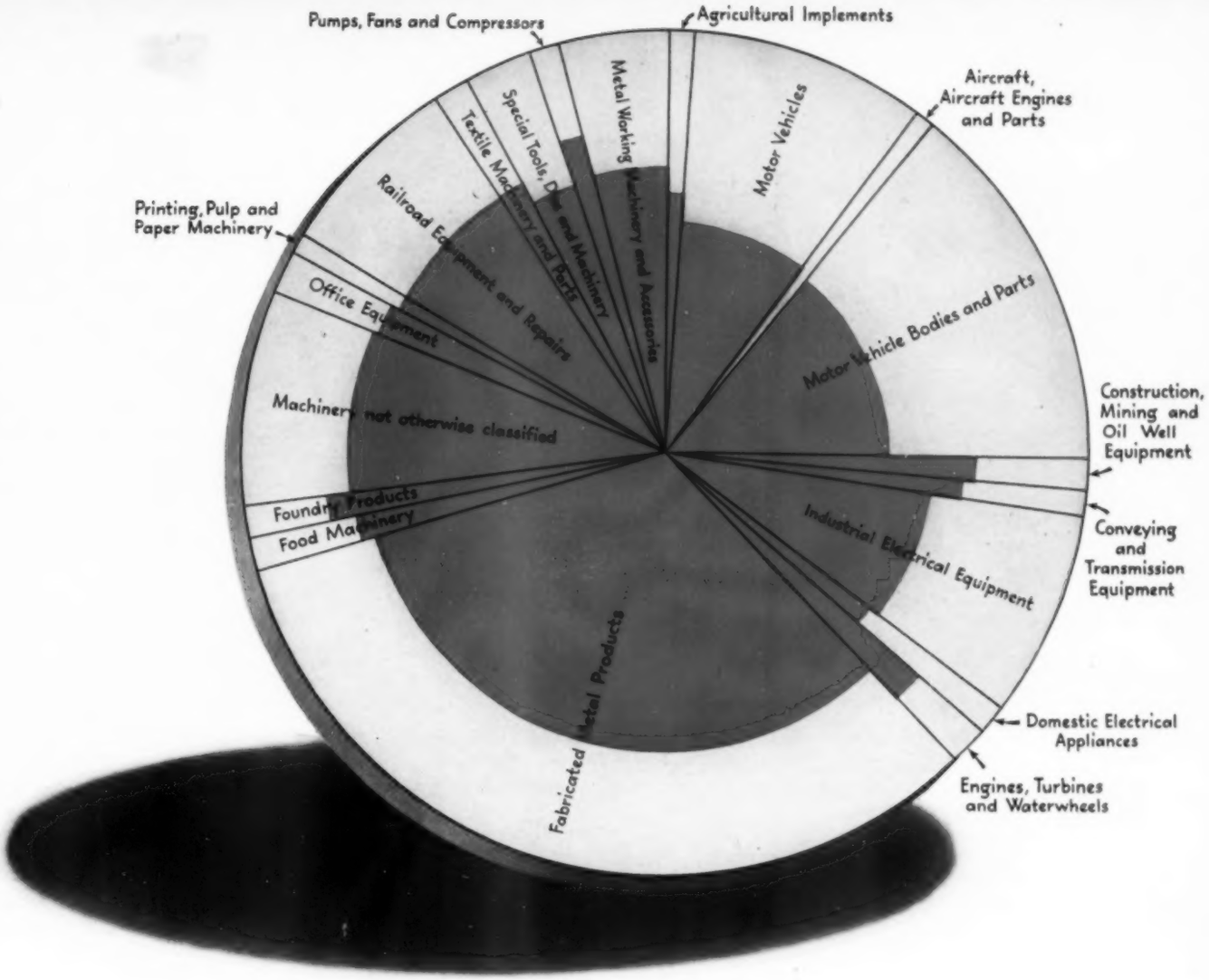
To show graphically the relative importance of industrial groups, and also the relative age of equipment in each group, a modified "pie chart" is employed. In this, the size of the segment, or slice, represents the proportion of metal-working equipment installed in each industrial division. The radius of the red portion of each slice indicates the percentage over ten years old.

Under the title, "How Much For New Equipment?", these same twenty divisions were discussed as to their expenditures for new facilities. This presentation is based on equipment in place regardless of the rate of buying. The largest division may not necessarily be the largest buyer, although in this survey the fabricated metal products group leads in both, with 33.5 per cent for total expenditures in the past five years and 32.7 per cent of the equipment in place.

Plants making motor vehicle bodies and parts account for the next largest portion of the total with 14.3 per cent, and motor vehicle manufacturers follow with 9.0 per cent. The parts group

Distribution of Metal-Working Equipment By Industrial Divisions

Industrial Divisions	Percentage of Total Machines Installed in Each Division	Percentage of Machines Over 10 Years Old
Agricultural Implements	1.1	61
Motor Vehicles	9.0	54
Aircraft, Engines and Parts	0.7	12
Motor Vehicle Bodies and Parts	14.3	52
Construction, Mining and Oil-Well	1.3	73
Conveying and Transmission	1.0	70
Industrial Electrical Equipment	7.8	63
Domestic Electrical Appliances	1.1	60
Fabricated Metal Products	32.7	70
Engines, Turbines and Waterwheels	1.5	79
Foundry Products	1.2	80
Food Machinery	1.2	74
Machinery not Otherwise Classified	8.3	74
Printing, Pulp and Paper Machinery	0.7	71
Metal-Working Machinery	4.2	67
Pumps, Fans and Compressors	1.2	77
Office Equipment	1.6	73
Special Tools, Dies and Machines	2.5	66
Railroad Equipment and Repairs	7.2	71
Textile Machinery and Parts	1.4	72



Segments indicate the proportion of machines in each industrial division; the radii of the red portions show the percentage of ten-year old equipment. Actual percentages are given in the table on the facing page

has spent more than its proportionate share in the past five years being responsible for 20.6 per cent of the total while the automobile industry proper did less than its share of spending with only 7.3 per cent of the total.

Builders of machinery, not otherwise classified, come next in number of machines in place with 8.3 of the country's total, closely followed by manufacturers of industrial electrical equipment with 7.8 per cent.

Considerable variation is evident in the percentage of old equipment in the twenty industrial divisions. Makers of foundry products give the poorest account of themselves with 80 per cent of their facilities over ten years old.

However, this figure refers only to machine shop equipment. Foundry equipment, of which plants in this group are large users, is reported separately and is only 58 per cent over the ten-year mark.

As might be expected the aircraft division makes the best showing with a percentage of old equipment of 12, although this is much worse than the 4 per cent reported five years ago.

The large fabricated metal products division is over the 65 per cent general average with 70 per cent of old equipment. The automotive divisions are better than average with 52 per cent for bodies and parts and 54 per cent for motor vehicles proper. Another important division, manufacturers of industrial electrical equipment, is just under the general average with 63 per cent of its plant facilities over ten years old.

The industrial classification points out those groups of manufacturers which have allowed their equipment to fall even below the poor showing made by industry in general. They should be particularly strenuous in their modernization plans if they are to maintain their standards of quality and to keep down their production costs.

Where the Equipment Is . . .

THE ILLUSTRATION on the facing page shows the concentration of metal-working equipment in the twelve Federal Reserve Districts and the percentage of old equipment in each district. The map of the United States has been cut into twelve sections each one of which corresponds to a district.

The height of each section is proportional to the percentage of the country's total equipment installed in that district. The red portion of each section indicates the percentage of ten-year-old machines.

In the survey presented in 1925 no geographical classification was attempted. In 1930, metal-working equipment was shown distributed in eight sections of the country. These sections were determined arbitrarily but had their basis in dealer territories; each section was made up of a number of such territories and followed their outer boundaries. Sections of the country which are essentially non-industrial and not covered by dealer organizations were classed as "open" in the 1930 report.

For the present inventory it was decided to use Federal Reserve Districts for the geographical classification. This phase of the survey is thus brought into harmony with established divisions upon which other statistical data are based. All of the twelve districts were included although five of them, the Sixth, Eighth, Ninth, Tenth and Eleventh, contain comparatively few metal-working plants.

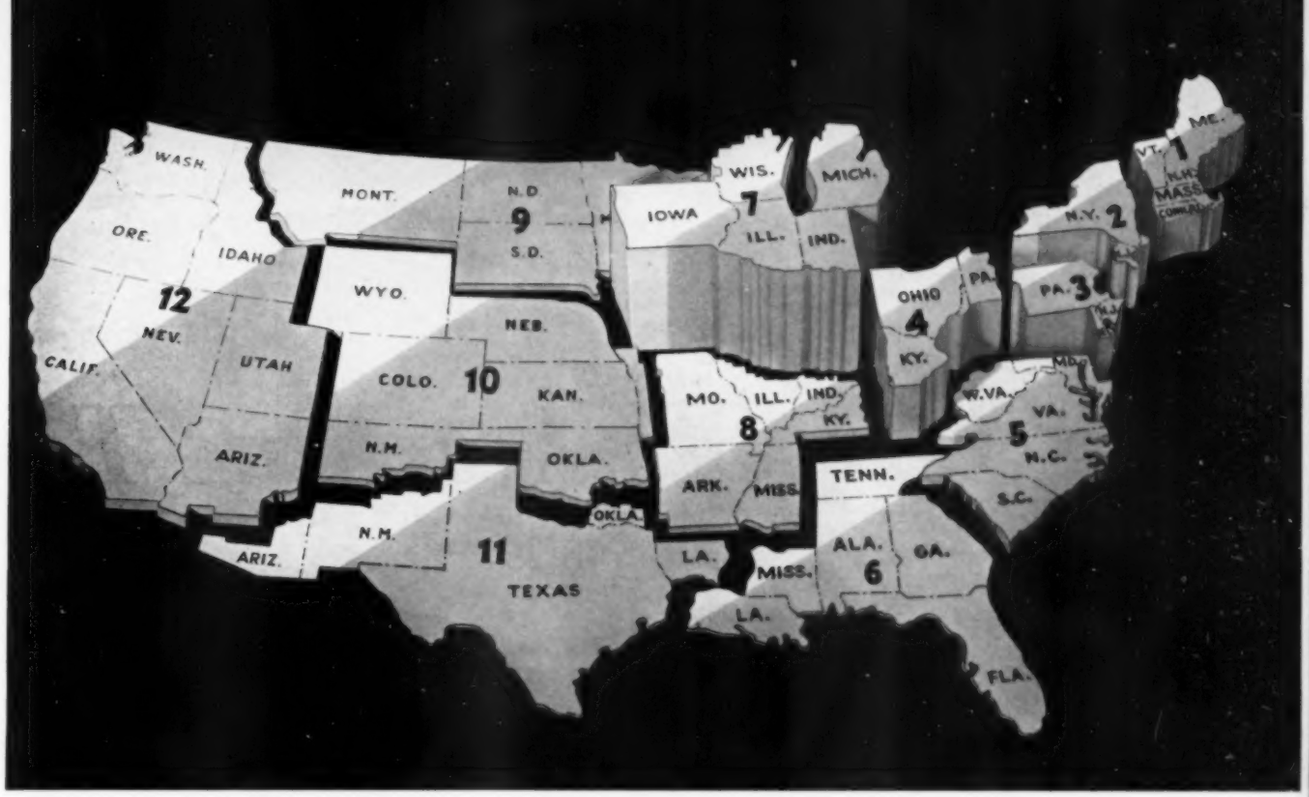
As regards old equipment the Eleventh District (Dallas) with 83 per cent appears to be the worst, although, because of the small total amount of metal-working machinery in this section, the figure does not indicate very much. Among the sections where metal-working really flourishes, the Seventh District (Chicago) is the best, with only 59 per cent of its facilities over the ten-year mark, while the Third District (Philadelphia) is the worst with a percentage of 71. The Third District has stolen last place from New England (First District) which held the cellar position five years ago.

No Improvement

This does not mean an improvement in New England; on the contrary the old equipment there has increased from 63 per cent in 1930 to 70 per cent in 1935. But Pennsylvania slipped even faster, going from 48 to 71 per cent in the same five-year period. In fact, none of the districts show any improvement. It should be remembered that comparisons with the 1930 survey are not exact because of the difference in geographical divisions used in the current breakdown.

Other districts which show up worse than the general average of 65 per cent for the entire country are the Second (New York) with 69 per cent, the Fourth (Cleveland) with 68 per cent, the Fifth (Richmond) with 74 per cent, the Sixth (Atlanta) with 77 per cent, the Ninth (Minneapolis) with 70 per cent and the Tenth (Kansas City) with 71 per cent.

The Eighth District (St. Louis) although containing only 1.2 per cent of the country's total equipment leads in the smallest relative amount



Federal Reserve Districts are indicated by number. The height of each district represents its proportion of the nation's total metal-working equipment; the red portions indicate the percentages of equipment over ten years old. The table on the left-hand page gives the percentages

of old equipment with 51 per cent over the ten-year limit. The Twelfth District (San Francisco) ties the Seventh at 59 per cent. These three Districts are the only ones of the twelve to have their plant facilities in better shape than the general average.

The Seventh District has by far the greatest number of metal-working machines—almost a third of the total in the United States. This district includes Detroit as well as Chicago together with such important metal-working centers as Milwaukee, Rockford, South Bend and Pontiac.

Second in concentration of equipment is the Fourth District (Cleveland), which includes Cincinnati and Pittsburgh, with 18.8 per cent of all the equipment. New York and New England are next and almost identical as regards equipment with 14.0 and 13.9 per cent of the total respectively. Eastern Pennsylvania (Philadelphia) has 10.1 per cent, the Fifth District (Richmond) 3.6 per cent and the Pacific Coast (San Francisco) 2.9 per cent. All other districts combined have only 4.4 per cent of the nation's metal-working tools.

The supplement to this number contains a table giving in detail the distribution of machinery in the twelve Federal Reserve Districts. This table gives the number of individual machines, the total in each district, the percentage in each district of the total for the country and the percentage over ten years old.

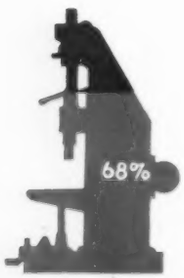
For example, it may be found that the Seventh District contains a total of 439,619 machines of which 8,359 are radial drills; and that 5,651 of these radial drills are over ten years old. The table also shows that the Eleventh District (Dallas) has only 1,245 metal-working machines, or approximately 0.1 per cent of the nation's total.

These figures were compiled primarily to show the degree of obsolescence in our metal-working plants and to point out the localities in greatest need of modernization. Plants in sections making a poor showing should be especially critical of their existing facilities; unless they are decidedly better than the average for their locality they should find many opportunities for profitable replacement.

In addition to its function in serving as a guide to production executives, this study may serve another purpose. Such data form an excellent basis for market analysis and for the planning of sales programs. Men who must meet the troublesome problems of sales and distribution will be able to put these figures to good use.

Old Machine Tools

RADIAL DRILLS



UPRIGHT DRILLS

CUTTER AND TOOL GRINDERS

EXTERNAL GRINDERS

FLOOR GRINDERS

AMERICAN metal-working machinery is well saturated with red ink. The advanced age of existing plant facilities, as shown by this survey, means that their continued use results in an enormous annual loss.

The silhouettes which appear at the edges of these pages represent types of machines in common use in machine shops. Each is part black and part red. The red portion, which in every case is greater than half, indicates the percentage of that particular type of machine that is over ten years old.

Similar silhouettes may be drawn for each of the 94 kinds of production equipment, 40 kinds of plant service and miscellaneous equipment and 38 kinds of foundry equipment given on the supplement to this number. The machines appearing on this page were not selected because they are particularly bad examples but because they appear in the greatest numbers in our shops.

Some of the types not shown on these pages are even worse as regards percentage of antiquity. Planers, for example, are 87 per cent over ten years old, bevel gear cutting machines 81 per cent, drop hammers 83 per cent, steam and air hammers 85 per cent and Lincoln-type milling machines 84 per cent. Centerless grinders, with only 19 per cent over the ten-year mark, make the best showing, naturally enough, because of their comparatively recent introduction.

Many other kinds of equipment have percentages of old equipment well above the general average of 65 per cent and thus betray themselves as particularly fit subjects for replacement. Wheel and axle lathes are 82 per cent old, centering machines 79 per cent old, rotary-cutter gear machines 76 per cent old, keyseaters 78 per cent old and engine lathes 75 per cent old. As the complete list appears on the supplement it will not be repeated here.

All the machines represented in this survey, whether in the red or black classification, are installed and either operating or ready for use, so it is presumed that they can turn out work after a fashion. They may not be worn out; they may not chatter or, in fact, present any visible evidence that their economic life is over. But despite the fact that they may be capable of operation for many years, they may be obsolete.

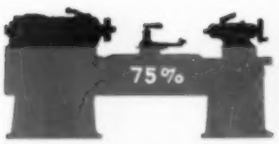
High Cost or Low Quality

There are two principal reasons for finding that a machine still able to turn out work is in reality a liability—high cost and low quality. If a new machine is available for performing a given task at a sufficiently lower cost to justify its acquisition, the equipment on the job is obsolete. If it can be shown that replacement of the old unit will justify itself in a limited period of time and leave a margin in increased production and future profits it is obviously wasteful to delay such replacement.

New machines cost money. But continued operation of old equipment after its economic life has passed may cost a great deal more. Hundreds of shops have paid many times over for equipment which they did not buy by insisting on housing mechanical relics that should have been retired.

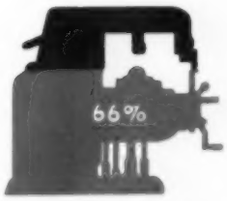
The other chief cause of obsolescence is

and Red Ink



ENGINE LATHES

TURRET LATHES



MILLING MACHINES

PUNCH PRESSES

CRANK PRESSES

SHAPERS

VERTICAL BORING MACHINES

inability to turn out parts to the precise limits required by modern engineering practice. Speeds have increased in nearly all kinds of equipment and quietness is prized more highly than ever before. These two considerations can be harmonized only by increased accuracy.

Precision Eliminates Fitting

In production lines and even in small-lot manufacture, hand fitting is giving way to interchangeability. Parts must be finish machined so they may be assembled without scraping and filing and the high cost and delay which such operations involve. Here again precision in machining is the remedy.

Machine tool builders have been prolific in the introduction of new designs even during the depression years when there was little likelihood of their cashing in on their inventiveness. They have gone forward courageously with research to discover new and better ways to remove metal. Their progress has been recorded in the pages of *American Machinist* and will be presented even more dramatically at the machine tool exhibition to be held in Cleveland next September. This display, the first of its kind to be given in six years, will form a tribute to the enterprise shown by machine tool builders under the most adverse economic conditions we have known.

The facts uncovered by this survey show that most users of metal-working equipment have not demonstrated the same degree of enterprise. The improved equipment has not been been put to full use, and so to date much of the effort expended in its introduction has been wasted.

It is not suggested that old machines be scrapped and replaced to stimulate industry in general or to reward the efforts of machine tool builders. Any business to exist must be founded firmly on the profit motive; so profit must be the basis of any sound equipment policy. It is fully realized that no specific replacement program can be based on the over-all figures presented here, but it is contended that these figures hold a warning that should stimulate metal-working plants to investigate their status.

The procedure for such analysis has been outlined many times on these pages. Each plant must determine the length of time in which it will require that a new piece of equipment pay for itself. Then, by comparing estimated performances of new machines with their current rates of production, it can ascertain whether the improved designs will meet this requirement.

The initial effort at self-analysis is important. Even if it leads only to the conviction that the present plant set-up is sound, the task is well worth doing. The chances are, however, that most shops will discover many ways by which unthought-of savings may be made.

One method of approach is to put each unit of equipment over ten years old on the "spot." Require that it justify its retention as a productive tool by placing it in competition with the latest equipment available for performing the same job, though not necessarily by the same method. In this way high cost units may be detected and the red ink deleted.

How the Figures Were Compiled

THE SUPPLEMENT to this number shows the total metal-working equipment in place in the United States as of the close of 1934 and also the number of units in use over ten years old. Ninety-four machine shop items are listed and classified into twenty major industrial groups and into the twelve Federal Reserve Districts. Each item is summarized by machine, by industry and by Federal Reserve District. For each summary and for the grand total a percentage of old to total equipment is shown.

In addition, plant service equipment and foundry equipment totals are given together with the number of units in these classifications over ten years old and the percentages they form of the totals. Readers who use these figures will want to know something of their compilation.

The results here presented are based on the returns from 10,000 questionnaires sent out by this paper. In preparing the mailing list, McGraw-Hill records were supplemented by over 100 code authority lists and trade association memberships in this field. Every effort was made to compile a list of names truly representative of the metal-working industry.

A copy of the questionnaire is not reproduced here, but the items on the supplement give a good idea of what it contained. In addition to the equipment entries, for total machines and those over ten years old, each firm was asked to state the number of wage earners employed as of December 15, 1934, and the dollars expended for new equipment during the three five-year periods: 1920-1924, 1925-1929, 1930-1934.

The returns were first divided into the twenty industrial groups indicated, and the total of wage earners of reporting firms was obtained for each group. This wage-earner total formed the basis of an extension factor for each industrial classification which, when applied to the machine units as reported, gave an approximate total of machines of each type in each group.

The factors were derived by comparing the wage earners for reporting firms with those given in the latest Census of Manufacturers (1933). It will be evident that there was a year's difference in the Census wage-earner figures, which were taken for December 15, 1933, and those reported on the questionnaires. To overcome this discrepancy the Census figures were modified by the ratio between the Department of Labor's index for December 1934 and that for December 1933. This put the Census figures on a basis comparable to that reported in the questionnaire.

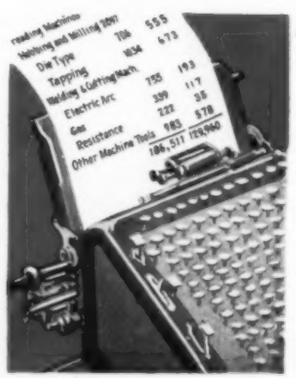
Then the modified Census total divided by the questionnaire total of wage earners gave an extension factor for each industrial group. These factors, applied to the total equipment returns on the questionnaires, resulted in the figures shown in the supplement.

Some such method of weighing industrial groups is essential because of the different percentages of companies reporting in the twenty industrial classifications. It would obviously distort the result to add directly returns from an industry where returns covered 50 per cent of the wage earners to one showing only a 15 per cent return.

These same extension factors were used in compiling the figures for the twelve Federal Reserve Districts.

After the individual items of machine shop equipment were entered, they were summarized horizontally to give machine totals and vertically to give industrial totals. Then per cent of old equipment and per cent of each item to the grand total for the industry were obtained for each summary.

On the geographical breakdown the vertical columns were added to give totals for the twelve Federal Reserve Districts and the corresponding percentages were obtained. Only total figures are shown for the plant service and miscellaneous equipment, and the foundry equipment breakdowns.



EDITORIALS

VOLUME 79 AMERICAN MACHINIST ESTABLISHED 1877 McGRAW-HILL PUBLISHING COMPANY, INC. NUMBER 9

K. H. CONDIT F. H. COLVIN
EDITORS

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Invitation to Racketeers

SENATOR WAGNER'S Labor Relations Act is intended to help labor, or at least he says it is. But will it?

No matter how you read it you can find only provision after provision to strengthen the hand of the racketeering labor organizer, and not a line to protect the worker himself from exploitation by the organizer or from coercion by his gangsters. On the other hand, great care has been taken to define what constitutes coercion on the part of the employer and to prevent him from doing anything that will help his employees to organize themselves as they choose.

In other words the door will be thrown wide open to the professional racketeer and he will practically be invited to live off the worker. Even under present conditions, which are bad enough under Section 7(a) of NIRA, the racketeer has seized control of a disturbingly large number of labor unions. Strikes, riots and murders have been the consequence.

As things are now the member of a union has no way of knowing what becomes of his dues, the tribute he pays to the organizer. The organizer need not account, and he does not. Senator Wagner is making no effort to correct this crying evil, and, to their great discredit, neither are the honest labor union officials, although they must see the danger to all they stand for which lies in this threatening situation.

If by some unfortunate chance this Wagner measure is enacted the immediate result will be a labor war that may well wreck the recovery that has at last made a feeble start. That war will be no joke. Industry has learned through bitter experience to fight fire with fire. Use of their own methods brought the Chicago bus strike racketeers to terms in short order. But in the meantime the public suffers inconvenience and possible injury and the majority of the workers, who want to work, lose their livelihood. And the employer pays the heavy cost of damages and lost orders.

POOR friends of the working man indeed are the men like Senator Wagner who would open the door to the labor racketeer. Employers who do everything possible to block this type of legislation to protect themselves are the real friends of their men because they would close the door to racketeering. It is too late to testify at committee hearings but not too late to point out to your Senators the dangers in the Wagner Bill, if you act at once.

Checking Our Defenses

IMMEDIATELY following the testimony of Messrs. Morgan and Lillienthal before the House Committee on Military Affairs, to the effect that there is an impending shortage of power necessary for the manufacture of munitions, a resolution was introduced instructing the Committee to investigate the plans for national defense.

If this investigation really gets to the bottom of things it is likely to unearth discrepancies in our manufacturing facilities far more serious than even the imposing two million horsepower shortage of power generating facilities alleged by the gentlemen from TVA. One good look at the overall figure from our 1935 inventory ought to be enough to give cold shivers to any official who will have to depend for the production of defensive armament on equipment with as high a percentage of obsolescence as that.

Couple with this deficiency the even worse condition of equipment in our Navy Yards and Arsenals (it averages thirty-three years in the Yards and even more in at least one of the Arsenals) and you have a situation that should awaken the government to a realization of how remiss it has been in countenancing the moves of the radical theorists to reduce the use of machinery. It is not possible to get out production on these old machines, nor is it possible to replace them overnight. Our machine tool factories would have to work at their 1929 peak for five years to restore our equipment to the not very satisfactory ratio of 1930, (see page 321).

Let's have the investigation. It might do a lot of good.

. CHIPS .

Washington—Roosevelt rushes relief plans under authority of new Works Bill . . . Concentration on grade crossing elimination and highway work has state engineering departments wondering where they are going to find enough civil engineers . . . Supreme Court promises early action on NRA test case while General Johnson tells Senate committee extension of NRA is only hope for capitalism and Brookings Institution publishes report saying it has retarded recovery . . . Senator Harrison introduces compromise bonus bill providing for payment mostly in negotiable bonds . . . House votes down all attempts to modify Security Bill and passes it . . . Farm Bureau reports serious damage from dust storms but is more concerned about another drought . . . House passes unworkable war profits bill and votes $272,000,000 for rivers and harbors . . . Secretary Ickes sharpens his tongue at the expense of Senator Long and Governor Talmadge, draws profane rejoinders and cuts off loans to both Louisiana and Georgia, which is much harder to answer . . . Unified aviation control urged by Howell Commission heads . . . Eastman's highway public carrier control bill is passed. . . . A. F. of L. President Green calls labor leaders to meet April 29 and force through the Wagner bill.

Foreign—France and U. S. sign treaty to end double taxation . . . Stresa conference apparently pleased France and Italy . . . League Council votes censure of Germany for violating Versailles Treaty and draws angry response from Hitler who also accuses British of letting him down . . . Italy spent $31,000,000 on Abyssinian mobilization . . . Threat of air raids terrifies Europe and leads to flock of joint defensive treaties . . . New British budget cuts income taxes for smaller payers . . . German elections for works councils bring general victory for the Nazis . . . Lithuania orders more men to arms.

Finance—Roosevelt raises silver price 7 cents by cutting seigniorage from 50 to 45 per cent . . . Treasury calls all outstanding Fourth Liberty bonds for redemption . . . Roper's advisory council urges long-term credit for small industries . . . Chicago is anticipating a big bull market in grains . . . Money rates down as official rate is cut to 1½ per cent . . . Germany fails to pay interest on Dawes loan bonds.

Industry—Threatened Akron rubber strike is avoided by compromise . . . Maritime strike on Pacific Coast is dreaded by business men there . . . Automobile workers overwhelmingly against unions in total vote but unions win elections in several other industries . . . Profit, billings and sales of General Electric are up in first quarter . . . Ford production of cars passes the half-million mark, company spent $100,000,000 in March . . . New inventions for sea warfare cause House to consider cutting down new ship construction from 24 to 12 . . . New England textile situation causing concern in Washington . . . Bantam Ball Bearing reports largely increased shipments in first quarter . . . Census of Manufactures shows that between 1929 and 1933 payrolls dropped 50 per cent while number of companies fell more than 25 per cent.

Indicators—Steel production improves slightly . . . Electrical power output sets new record for the week . . . Carloadings up . . . *Business Week's* index drops a little to 62.7.

Opposition Grows As NRA Senate Hearings Continue

WASHINGTON—Hearings before the Senate Finance Committee and communications reaching that committee indicate that much more opposition to NRA exists than had been anticipated. Neither business nor labor have made a whole-hearted case for its continuance.

In the beginning labor was strong for it. As it has developed, however, industry has had more voice in the organization than labor expected. Business was attracted to NRA as a way to short circuit the anti-trust statutes, but the extent of that protection is doubtful. As a consequence business is far from sure that the benefits are sufficient to justify the governmental regulation involved.

The investigation of NRA has developed that the chiseler has friends. Some go so far as to contend that the chiseler is the heart of the capitalistic system. He makes competition real and keeps every one on their toes in the effort to get manufactured products to the consumer at the lowest cost.

In a socialistic economy the chiseler can be eliminated, but the investigation of NRA has gone far enough to indicate that there are many who think there is no way of eliminating the chiseler without undermining the principles along which American business always has been conducted and without retarding recovery. In fact, there has been abundant testimony in which the NRA is held to have retarded business recovery in having held up prices at a time when they upset the normal forces that restore economic equilibrium.

The Federal Trade Commission, which feels that it should be the agency dealing with everything pertaining to trade practices, is making the most of the opportunity by showing how active it can be in bringing unfair trade practice cases and in furnishing information to the Senate committee.

There are some who think the NRA is the Administration's worst blunder. While they do not expect acknowledgment of failure before the election, particularly when 7,000 jobs are involved, they predict that the organization will have been pushed out of the picture before the end of the two-year extension Congress is expected to grant.

Soviet Purchases More British Machine Tools

For the first two months of the current year, exports of British machine tools to the Soviet Union amounted to £96,012 as compared to £25,833 in the corresponding period of 1934. As pointed out by Consul W. W. Heard, Birmingham, Russia has been the chief overseas market for British made machine tools for some time. During 1932, total British machine tool exports to Russia were valued at £2,552,937, in 1933, £623,314, and in 1934, £549,429.

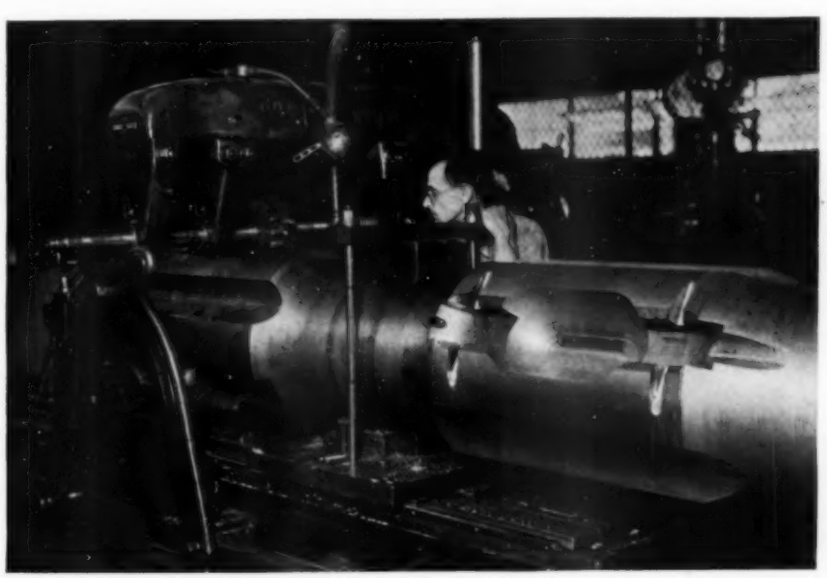
While British machine tool trade with Russia during the first two months of 1935 is in advance of last year, the orders are of a distinctly non-recurrent character, and it is generally felt that the volume of Russian business in 1935 will not reach the peak of 1932.

Orders Ahead of Output In British Tool Plants

BIRMINGHAM, ENGLAND—The rush of orders which followed the machine exhibition during the latter portion of 1934 has resolved itself into a steadier and more consistent demand which is generally regarded as reflecting a definite recovery in the metal-working and machine tool industries. Deliveries from the majority of local machine tool makers are reported to be subject to from eight to twelve weeks delay, according to William W. Heard, American consul.

Principal activity continues to be caused by the production demands of the automotive industry and accessory trade, but there is more of a general spread of orders for other industrial uses than was the case a few months ago. An important factor at present is the virtual lack of supply of second-hand machine tools which, for a number of years, had an adverse effect on the sale of the new product in England. While the home market is largest an appreciable increase in export demand has also been recorded. This has been particularly noticeable in trade with the British Dominions with which the British tools enjoy preferential treatment.

There is an increasing tendency by British manufacturers of machine tools and other industrial machinery, to make provision for built-in motor drives, which are claimed to offer numerous advantages, including the elimination of bevel gears, belts, chains, and space economy and better appearance. To meet this development an important local electrical motor concern has recently introduced a range of stator and rotor units made in sizes adaptable to industrial machinery. The firm is at present engaged in extending its machine shop to an added area of 25,000 sq.ft.



***Biggest Reamer*—With a weight of 11,000 lb., the world's largest three-point oil reamer is 18 ft. long and 22½ in. in diameter. Six pockets for the cutters are machined on a Cincinnati 5-48 Hydromatic miller using an O.K. inserted tooth cutter**

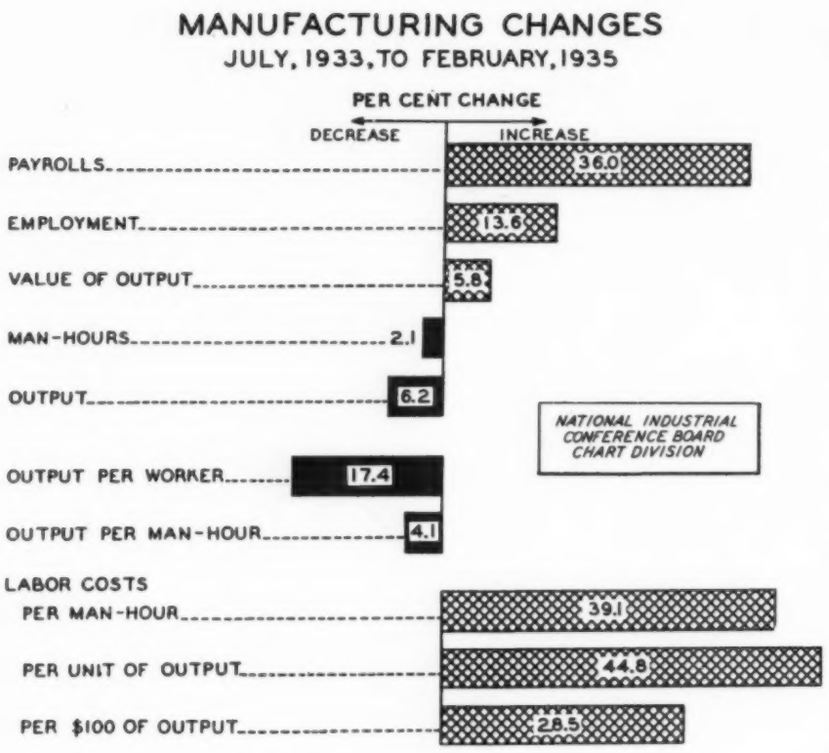


Table I—Index of Orders Based on Volume of Shipments for 1926

Month	Index of Orders: Domestic	Foreign	Total	3 Months' Average Index	% Foreign to Total Orders
1934—September	29.4	6.8	36.2	37.4	19
October	35.1	8.8	43.9	40.5	19
November	43.1	9.3	52.4	44.2	17
December	51.5	14.6	66.1	54.1	21
1935—January	52.0	13.5	65.5	61.3	20
February	41.2	10.9	53.0	61.5	20
March	48.5	13.8	62.3	60.3	21

Table II—Index of Orders—By Size of Companies

Group A—Companies reporting year's sales in 1926 of $200,000 or more:

Month	Index of Orders: Domestic	Foreign	Total	No. of Reports	% Foreign to Total Orders
1934—September	28.7	7.1	35.8	94	20
October	34.9	9.4	44.3	96	21
November	43.4	9.8	53.2	89	19
December	51.3	15.1	66.4	91	23
1935—January	51.6	14.3	65.9	91	22
February	42.1	11.4	53.5	98	21
March	48.0	14.4	62.4	94	23

Group B—Companies reporting year's sales in 1926 of less than $200,000:

1934—September	39.4	3.1	42.5	81	7
October	37.5	1.7	39.2	82	4
November	38.7	2.1	40.8	82	5
December	55.6	7.3	62.9	76	12
1935—January	57.1	1.9	59.0	78	3
February	42.1	4.5	46.6	81	10
March	55.7	5.5	61.2	78	9

Table III—Distribution of Orders

(Shown by indexes of individual companies)

New Orders in % of 1926 Shipments	Number of Reports in Each Index Group: Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
200 or more	3	5	4	9	10	6	6
100–199	12	15	15	25	21	19	25
90–99	2	3	4	5	5	5	8
80–89	5	3	4	4	10	3	5
70–79	6	6	7	6	8	10	9
60–69	2	9	9	7	10	8	7
50–59	9	12	12	18	10	18	15
40–49	15	8	16	16	13	18	21
30–39	16	19	16	14	12	21	21
20–29	24	26	17	17	21	23	13
10–19	29	31	23	24	22	18	23
Less than 10	52	41	44	22	27	30	19
Total Reports	175	178	171	167	169	179	172

Conference Board Finds Output Per Worker Lower

Because of a 36 per cent rise in payrolls, labor costs in manufacturing industry increased 28.5 per cent per unit of income and 44.8 per cent per unit of product during the nineteen-month period under the codes from July, 1933, to February, 1935, according to a report released by the National Industrial Conference Board.

During this period, production was 6.2 per cent lower in volume, but by reason of higher prices now prevailing, 5.8 per cent higher in value. Employment rose 13.6 per cent, but man-hours, because of a decline in production and reduced hours, fell to 2.1 per cent below the July, 1933, level, as the result of short hours the output per worker declined.

In comparing manufacturing production in February, 1935, with that of the preceding month, the report shows increases of slightly more than 3 per cent in volume, and a little over 4 per cent in gross income. Payrolls by an increase of 7.8 per cent represent the most striking advance during February. Volume of production parallel the advance of employment and man-hours increased 6.8 per cent.

March Machine Tool Business Shows Gain

With an increase in the volume of orders of about 18 per cent over February, March machine tool business recovered practically all of the loss sustained in the preceding month. The index reported by the industry's Supervising Agency rose to 62.3, only slightly below the January figure of 65.9. The three-month moving average, on which the indices trend is based, is off only slightly to 60.3.

The average for the past four months is well above that for a year ago (61.7 against 55.5) and shows every indication of a more sustained demand. Last year the March index was only 48.1. If the usual seasonal influences govern, the volume of new business may slow down over the next few months, but it appears reasonably certain that the trend line will not go as low as in the summer of 1934.

Foreign orders increased in March over February in about the same proportion as the improvement in domestic business, which is a favorable indication. As shown in Table III, the number of companies reporting business less than 20 per cent of 1926 level is steadily growing smaller.

Last Year's Troubles Absent, Detroit Deliveries Push Upward

DETROIT—With a March output of 447,561, first quarter production of automobiles was 1,108,591, a total exceeded only three times (1924, 1926 and 1929) in the history of the industry. April production, currently running in excess of 100,000 units per week, is expected to better March figures. There is no indication at present that this high rate of output will not be maintained at least well through May. Dealer stocks are, in many cases, still short and current sales have prevented building these up in March. Olds, as an example, shipped 18,432 cars to dealers and 17,193 were sold at retail while comparable figures for Pontiac were 17,802 and 17,180.

Employment Steady

Pressure on parts suppliers is not generally as great now as it was in January when production banks were being built up. In the last week of March and first week of April, supplier schedules in some cases were drastically cut in order to work banks down to a six-day basis. This adjustment period, however, is completed and the schedules have regained much of their former level. The curve of employment for the Detroit area is markedly different from that of last year. Then the delay caused by the tool strike, the threatened strike of production workers and the increase in car prices led to a flood of orders from dealers bringing a great bulge in the employment curve to May with marked recession as buying reacted unfavorably to the price increases. None of these three influences is currently at work. Beginning with 200,000 on January 1, the number employed increased to 240,000 on February 1, and has remained at that figure through March and early April.

Retail deliveries are still climbing upward; 205,412 units were sold at retail in February and 240,000 are estimated by R. L. Polk Co. for March. General Motors retail sales in the United States totalled 126,691 as compared with 77,297 in February. Ford retail sales were 126,783 for the same period, the largest month's sales since June, 1930. For the week ending April 6 Dodge had the largest sales volume since May 1, 1926. Oldsmobile sales in March topped the previous monthly peak set in May 1929 by 30 per cent. Scattered reports from other companies show the same upward trend.

The size of the used car inventory is causing concern in many quarters; the N.A.D.A. is initiating a survey of the situation national in scope. Competition in large centers has forced the top blue book figure on trade-in cars, and the policy of some companies in increasing dealer outlets has not helped matters. Data on car financing issued by the Department of Commerce indicate that there was a 68 per cent increase in new cars handled in January and February this year over last, and only a 28 per cent increase in used cars. Some estimates place current used car stocks as high as a 60-day supply, considerably above what is considered a satisfactory level. Lower book values issued a few days ago and the fact that a large percentage of this inventory is composed of small low-priced cars are favorable factors.

Little change in the machinery situation is to be noted. January and February were good months but March showed a considerably smaller volume. At present Ford purchases are the main support with requests for quotations generally coming in well. Sales are about on the level of last November which is considerably better than the situation at this time last year. The first quarter's business is reported in some quarters as being the best in three years.

Main reliance for future business is placed on the fact that many companies, excluding sheet-metal machinery, have so far bought little and on the necessity for improving efficiency due to failure of profits to increase to the same extent as sales. Taking the reports of eleven representative companies as an example, sales increased in 1934 over 1933 by 46.3 per cent while total expenses increased 49.9 per cent, resulting in an actual decrease in the per cent of profits to sales.

The die industry is in the same situation as last reported, about 10—15 per cent of capacity with no immediate prospect of betterment; one plant shipped in March one-seventh of

• INDUSTRIAL REVIEW •

• After a spotty first quarter, the machinery industry finds buyers still hesitant. With the exception of a few localities, labor peace prevails, but fear as to the consequences of the Wagner Bill, if passed, is no doubt responsible for holding up many orders. However, April finds the level of the first quarter maintained and in some instances bettered.

• Despite difficulty in getting final closings, New England reports some sizable orders and new inquiries that look favorable. There is evidence of a shortage of skilled mechanics in this section. Outside of government business, Philadelphia finds sales below expectations. Deliveries are lengthening to four or six months, on some machines, and industrial buyers may later regret that they were not more forehanded in their replacement programs.

• Pittsburgh finds current sales about 100 per cent better than the below average showing made in March. The State compensation bill is disturbing to business as well as proposed national legislation.

• Orders are scarce in Cincinnati, but inquiries are better. Some stimulation from government buying is anticipated although substantial improvement is not looked for until Congress adjourns.

• April sales in Cleveland will exceed those for March, but most of the buying is classed as "involuntary." This term is applied to purchases forced by special conditions rather than planned replacement. With both automobile and parts makers tooled up to present demands, machinery orders have showed signs of slackening in Toledo and Detroit.

• After a rather poor March, sales in Chicago have revived. An encouraging feature is that orders come from widely separate points. Milwaukee reports the best month in over a year with current business holding well. With prospects of a second quarter equal to the first, Indianapolis suppliers have no fault to find.

• In St. Louis the railroads have become interested in shop equipment for the first time in many months. Buying is moderate but steady. The Pacific Coast is enjoying the best month in a long time and is optimistic about the future. This view holds despite several troublesome strikes and threats of others.

a normal month's business. With a considerable reduction in volume due to consolidations and consequent interchange of parts between different cars, and a distinct disadvantage in code hours, this industry is being hard pressed and affords a good example of the difficulty and damage likely to result from industry control from a central point. Operating under discrimination in code hours, difficulty is encountered in producing work for assembly plants at less than they can do the work themselves and still leave a profit for the jobber. Increase in material costs and inability to buy and stock in quantities due to varying customer specifications is an additional handicap.

In addition to controversy as to company policy control, the Hupp Motor Co. suffered a strike of roughly half of its staff of workers the first few days of the month. Difficulty arose over contemplated introduction of a group incentive wage plan and discharge of union members for certain irregularities. The trouble is now settled by negotiation.

A committee has been appointed to consider the question of amalgamation of the pattern makers union with the M.E.S.A.

The wish-bone frame and front wheel suspension developed by the Leaf Spring Institute last fall has been tested on three delivery truck jobs by the enginering division and, in the Belgian block test gave results beyond expectations.

The New York Auto Show is scheduled November 2, 1935, by vote of the A.M.A. on April 12, thus apparently returning to the manufacturing sponsorship of the annual event discontinued last January.

Expansion at the Olds Motor Works is provided through acquisition of the plant built for the Durant Motors Corporation. The Fisher Body Company will occupy this space with their present plant used for Olds operations. With completion of rearrangement and machinery installation production is to be increased to 1,500 per day from a present output of 900.

R. M. Lippard Made A.S.T.E. President

At the meeting of the American Society of Tool Engineers, in Detroit, on April 11, the following officers were inducted to serve until April, 1936:

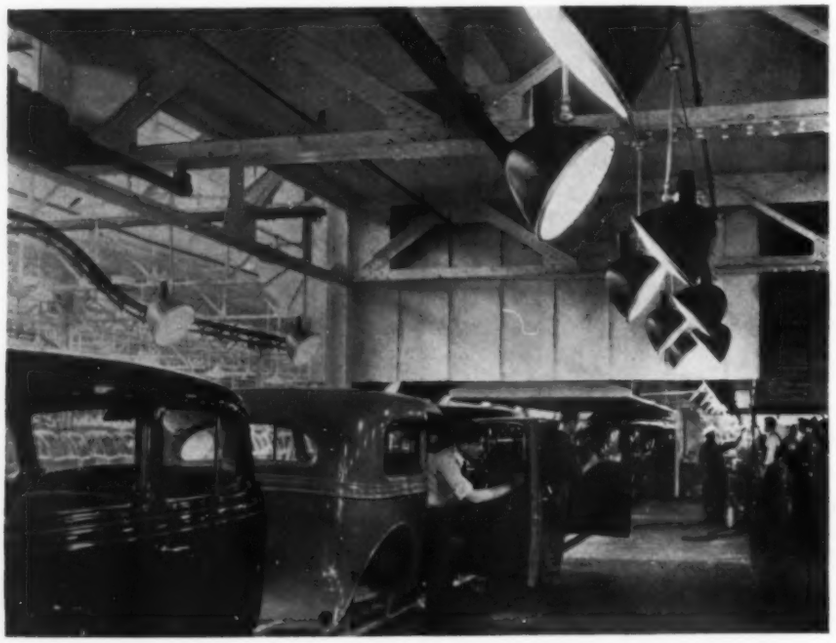
PRESIDENT — Robert M. Lippard, Heald Machine Co.

1ST VICE-PRESIDENT—Ford R. Lamb, Consolidated Machine Co.

2ND VICE-PRESIDENT—W. Maxwell Gray, Congress Tool & Die Co.

TREASURER—B. L. Diamond, Duplex Engineering Co.

SECRETARY—Albert M. Sargent, Pioneer Engineering & Manufacturing Co.



***Synthetic Daylight*—Chevrolet bodies are fabricated in a new Fisher body plant immediately adjacent to the new assembly plant in Baltimore. Shadow-proof lighting effects provide workers with true color perspective during assembly operations**

R. E. W. Harrison Speaks On Effects of Machinery

In an address at the University of Tennessee, Knoxville, R. E. W. Harrison, chief, Machinery Division, Bureau of Foreign and Domestic Commerce, demonstrated statistically that modern machinery has given more jobs than it has taken.

"There has been a consistent effort during the depression," Mr. Harrison said, "to discredit and restrict the progress of mechanization on the grounds that it is a breeder of unemployment. Although it is obvious that a given machine may tend to eliminate hand labor, often in a spectacular way, the machine, year by year, contributed to a larger volume of national employment until the crash of 1929 which was due to financial rather than technological factors. Increased mechanization now is not a barrier to re-employment but is one of the ways out of the depression."

New Chevrolet Plant Opened at Baltimore

On April 9, Chevrolet's 80,000-car-a-year assembly plant opened at Baltimore, Md., and is now in production on both passenger cars and trucks. On the occasion of the formal opening, speakers included Governor Harry W. Nice of Maryland, Mayor Howard W. Jackson of Baltimore, Alfred P. Sloan, Jr., president and W. S. Knudsen, executive vice-president of General Motors; M. E. Coyle, president and general manager of Chevrolet, and Adam J. Hazlett, president, Association of Commerce.

Though called an assembly plant, the Baltimore operation is designed not only for fitting together component parts that comprise complete automobiles, but for performing scores of preliminary and finishing operations that come under the head of manufacturing. The main shop is 600 ft. wide and 980 ft. long. A third of this building, on the South side, is the Fisher Body Plant, separated by a brick partition except for a portal by which bodies roll on conveyors to the car assembly plant.

There is also a car conditioning shop, 80x245 ft., where cars are given their final tune-up and inspection.

While noteworthy for its mechanical equipment the new plant is equally remarkable for its provisions for the safety, health and comfort of its workers. Particularly important are the provisions for exhausting fumes from the paint booths, and for the illumination of the plant with diffused light.

N.A.M. Recommends Deferring Labor Bill

Congress was urged by the Board of the National Association of Manufacturers, meeting at the Waldorf-Astoria, New York, on April 18, to lay aside legislation affecting the right of the Federal Government to regulate interstate commerce until the Supreme Court has passed upon the extent of the Government's jurisdiction. This would include not only extension of NIRA, but the Wagner Labor Disputes bill, and the 30-hour week bill as well. The statement by the board on this topic said in part:

"A decision by our highest court will dissolve the fog of uncertainty which has hung over this country for the past two years and tended to contribute to the multiplying obstructions which have beset the pathway of recovery.

"In view of the fact that 21 Federal courts throughout the United States have emphatically declared that various assertions of the right of Federal authority to control local relations under the guise of the commerce power were all outside the authority of the Federal Government, it is important that pending legislation relating to the 30-hour week bill, Wagner Labor Disputes bill, and the extension of the N.I.R.A. be held in abeyance until the Court responds to the request of the government to clearly define its powers."

• PERSONALS •

R. F. BLACK, formerly president of the Brockway Motor Truck Corp. is succeeding A. G. BEAN as president of the White Motor Co. Mr. Bean has been named chairman of the board.

S. S. BATTLES has become president of the Midwest Stamping & Enameling Co., Morrison, Ill. He was formerly chief engineer of the Ingersoll Steel & Disk Co.

GUSTAVE OLSON, formerly works manager of the Oliver Farm Equipment Co., is now works manager of the John Deere Tractor Co., Waterloo, Iowa.

GEORGE H. RALLS has resigned as director of sales of the parts division of the Chrysler Corp. to become president of Pressure Castings, Inc., Cleveland, Ohio. Mr. Ralls was long identified with the Gabriel Co., manufacturers of hydraulic shock absorbers.

JOSEPH W. ROYER, works manager of The Medart Co., St. Louis, Mo., was recently elected vice-president in full charge of manufacturing.

J. R. TILLMAN

JOHN R. TILLMAN, for several years head of the tool engineering department of The Bullard Co., Bridgeport, Conn., has been appointed as assistant to DUDLEY B. BULLARD, vice-president in charge of engineering. Mr. Tillman's new capacity as chief executive engineer combines the supervision of all departments of engineering.

• OBITUARIES •

CHARLES F. COWDREY, 64, of Fitchburg, Mass., died recently at St. Petersburg, Fla. He was well known in the motor industry as an inventor and manufacturer. He developed an automobile brake tester in 1919. Mr. Cowdrey was treasurer of the C. H. Cowdrey Machine Works and president of the Cowdrey Products Co.

FRANK D. DORMAN, 76, since 1925 treasurer and general manager of the Automatic Machine Co., Bridgeport, Conn., died April 8. From 1905 to 1912, Mr. Dorman was vice-president and general manager of the Maxwell-Briscoe Motor Co., Tarrytown, N. Y., and an associate with W. C. DURANT in the formation of the original Chevrolet Motor Co.

R. C. LIND, founder and president of the Rockford Machine Tool Co., died April 13 at the age of 79. Mr. Lind went to Rockford from Smoland, Sweden, in 1871 with his parents. He began his industrial career early and became identified with many local enterprises, including the founding of the Rockford Machine Tool Co. in 1905.

B. A. SNOW, who first entered the employ of the Brown & Sharpe Co. in 1902, and who for the last eleven years has represented this company in Pittsburgh, died of pneumonia on April 17.

J. H. WHITING

JOHN HILL WHITING, chairman of the board, Whiting Corp., Harvey, Ill., died April 6. For over 50 years he was closely associated with the casting arts, and, as the pioneer manufacturer of cost-reducing equipment for foundries, contributed materially to the growth of the foundry industry in America. Mr. Whiting started as a clerk in the foundry of the Michigan Car Co., Detroit, Mich., and rose rapidly until he became general superintendent of the plant. Later he formed a company for the production of improved foundry equipment, under the name of the Whiting Foundry Equipment Co., which has since become the Whiting Corp. and which branched out into other lines.

• BUSINESS ITEMS •

The Industrial Plants Corp., 90 West Broadway, New York, N. Y., announces the sale at public auction of the entire land, buildings, machinery and equipment of the Covington Machine Co., Covington, Va. The auction is to be held May 1st, at 10 A.M.

The Triplex Machine Tool Corp., 125 Barclay St., New York, N. Y., having taken over the exclusive United States and Canadian agency for the jig boring machines and equipment of the Société Genevoise, has appointed the following dealers as exclusive representatives in the United States and Canada: Walter S. Ryan Co., Royal Oak, Mich.; F. W. Schiefer Machinery Co., Rochester, N. Y.; Neff, Kohlbusch & Bissell, Chicago, Ill.; W. E. Shipley Machinery Co., Philadelphia, Pa.; Blackman & Nuetzel Machinery Co., St. Louis, Mo.; Barney Machinery Co., Pittsburgh, Pa.; Joseph C. Fletcher,

San Francisco, Calif.; Galvin Machinery Sales, Buffalo, N. Y.; E. A. Kinsey Co., Cincinnati, Ohio; Marshall & Huschart Co., Indianapolis, Ind.; H. A. Smith Machinery Co., Syracuse, N. Y.; Williams & Wilson, Ltd., Montreal, Canada.

The Cadillac Machinery Co., Detroit, Mich., has been appointed exclusive representative in Eastern Michigan for the Machine Tool Division of Porter-Cable Co. and the Greenfield Tap & Die Corp.

Corporation Reports

Company	1934 Earnings	1933 Earnings	1935 Earnings First Quarter	1934 Earnings First Quarter
Eaton Mfg. Co.			$605,272	$341,151
Emsco Derrick & Equipment Co.	$444,164	d$2,545		
Independent Penumatic Tool Co.	$672,280	$190,459		
Ingersoll-Rand Co.	$3,048,088	$164,184		
Motor Products Corp.			$292,285	$81,125
New York Air Brake Co.			$10,836	d$115,567
Poor & Co.	$296,664	d$236,998		
Signode Steel Strapping Co.	$95,182	$43,957		
Transue & Williams Steel Forging Co.			$54,673	$16,541
Underwood Elliott Fisher Co.			$719,043	$706,281
Union Metal Mfg. Co.	*d*$74,657	*d*$79,307		
United States Radiator Corp.	**d*$464,481	*d*$888,055		
Wright Aeronautical Corp.	$966,153	$364,606		

d—Deficit.
*Fiscal year to January 31, 1935.

• MEETINGS •

American Gear Manufacturers Association. Annual meeting, May 14-15. Penn-Lincoln Hotel, Wilkinsburg, Pa. J. C. McQuiston, manager-secretary, Penn-Lincoln Hotel, Wilkinsburg, Pa.

American Institute of Electrical Engineers. Summer convention, June 24-28. Ithaca, N. Y. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

American Welding Society. Annual meeting, April 25. Engineering Societies Building, New York, N. Y. M. M. Kelly, secretary, 29 West 39th St., New York, N. Y.

National Metal Trades Association. Annual meeting, May 15-16. Hotel Cleveland, Cleveland, Ohio. Homer D. Sayre, secretary, Peoples Gas Building, Chicago, Ill.

Refrigerating Machinery Industry. Annual meeting, May 23. The Homestead, Hot Springs, Va.

United States Chamber of Commerce. Annual meeting, April 29-May 2. Washington, D. C.

• EXPORT • OPPORTUNITIES

W. T. Watson, 25 Corsica St., Highbury, London, N. 5, England, wishes to get in touch with American firms manufacturing machinery for marking scales on thermometers.

Reapers, binders, rakes, threshers, plows, harrows, and hoes. *8754. Gox, France.

Compressors for domestic and commercial refrigerators. *8768. Buenos Aires, Argentina.

Packing-room machines and appliances. *8751. Melbourne, Australia.

Refrigerating equipment, self-contained lighting plants, and heating units, using kerosene or gasoline power. *8767. London, England.

Compressors for commercial refrigerating units. *8712. Beveren, Belgium.

Dyeing machines and equipment for hosiery. *8738. Cali, Colombia.

Engines, diesel, stationary, small. *8714. The Hague, Netherlands.

Engines, marine, diesel, high-speed, boat type, complete with fittings. *8734. Monrovia, Liberia.

Paper-bag-making machinery, for manufacture of kraft paper bags. *8711. Nuevo Laredo, Mexico.

Shoe-making machinery. *8733. Melbourne, Australia.

Tile manufacturing and polishing machinery. *8713. Manila, P. I.

*Interested American firms and individuals may obtain the names and addresses of the foreign firms making these inquiries upon application to the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, or any district or cooperative office.

• PATENTS •

April 2, 1935

Metal-Working Machinery

Machine For Forming Wire Fabric. Arthur Ernest Blashill, Sheffield, England. Patent 1,996,061.

Automatic Multiple Spindle Machine. Alfred E. Drissner, Cleveland, Ohio, assigned to the National Acme Co. Patent 1,996,368.

Gear Cutting Machine. Harry Edgar Kitchen, Buffalo, N. Y., assigned to Farrel-Birmingham Co., Inc. Patent 1,996,380.

Machine for Dressing Revolving Grinding Wheels. Harry Frederick Atkins, Old Fletton, Peterborough, England. Patent 1,996,396.

Profiling Machine. Alden M. Drake, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,996,408.

Profiling Tracer. Robert D. Shaw, Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,996,438.

Automatic Templet Following Profiling Tracer. Robert D. Shaw, Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,996,439.

Machine for Fabricating Radiator Cores. Martin G. Boerger, Racine, Wis., assigned to Modine Manufacturing Co. Patent 1,996,566.

Tools and Attachments

Automatic Work Clamp and Length Gauge. Benjamin G. Hardy, Merchantville, N. J., assigned to Albert P. DeSanno, Jr. Patent 1,996,373.

April 9, 1935

Metal-Working Machinery

Tapping Machine. Theodore H. Doan, Cleveland Heights, Ohio, assigned to the Foot Burt Co. Patent 1,996,752.

Method and Apparatus for Welding Tubes. Ernest M. Sims, Elkhart, Ind. Patent 1,996,775.

Forging Press. Bertrand D. Marshall, Hugh Dean and John Moorhead, Detroit, Mich., assigned to General Motors Corp. Patent 1,996,818.

Automatic Forging or Pressure Machine. Hugh Dean, Detroit, Mich., assigned to General Motors Corp. Patent 1,996,819.

Grinding Machine. Clarence C. Stevens, Forestville, Conn., assigned to General Motors Corp. Patent 1,996,842.

Welding Apparatus. Bruce Burns, Santa Monica, Calif., assigned to the Northrop Corp. Patent 1,996,901.

Metal Cutting and Forming Apparatus. Raymond E. Beegle, East St. Louis, Ill. Patent 1,997,098.

Machine for Coiling Metal Strip. Michel Nigro, Worcester, Mass., assigned to Sleeper & Hartley, Inc. Patent 1,997,197.

Rotor Cutting Machine. William H. Nichols, Waltham, Mass. Patent 1,997,227.

Finishing Tool. Homer C. Warner, Cleveland, Ohio, assigned to the Lees-Bradner Co. Patent 1,997,244.

Punch Press. Vitus A. Boker, Minneapolis, Minn. Patent 1,997,292.

Milling Machine. Lester F. Nenninger and Sol Einstein, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,997,338.

Automatic Screw Making Machine and the Like. Albert Frederick James Wright, Walthamstow, England. Patent 1,997,353.

Hammering Machine. Walter Gleissner, Weissenfels-on-the-Saale, Germany, assigned to Nollesche Werke Kom. Patent 1,997,548.

Grinding Machine. Millard Romaine, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,997,551.

Tools and Attachments

Welding Electrode. John H. Deppeler, Weehawken, N. J. Patent 1,996,794.

Work Holder for Grinders. Charles Ira Lott, Lansing, Mich. Patent 1,996,873.

Rotary Abrading Tool. Harold F. Skillings, Arlington, Mass., assigned to the Blanchard Machine Co. Patent 1,996,980.

Rotary Gear Cutting Tool. Ernest Wildhaber, Brooklyn, N. Y. Patent 1,996,987.

Cutting Torch. Arthur J. Fausek and Irving F. Fausek. Patent 1,996,991.

Sharpening Tool. Clarence T. Rottler, Seattle, Wash. Patent 1,997,183.

Processes

Method of and Means for Bending Tubes. Lester W. Snell, Alton, Ill. Patent 1,996,838.

Method of Making Propeller Blades. Vincent Bendix, South Bend, Ind., assigned to Bendix Research Corp. Patent 1,996,850.

Method of and Apparatus for Forming Slugs for Use in Extrusion Processes. Walter T. Davis and John A. McGinnis, Wheeling, W. Va., assigned to Wheeling Stamping Co., Wheeling, W. Va.

Method of Preparing and Nitriding a Ferrous Article. Albert W. Morris, Springfield, Mass., assigned to Moore Drop Forging Co. Patent 1,997,005-1,997,006-1,997,007-1,997,008.

American Machinist

REFERENCE BOOK SHEET ©

Tap Drill Sizes—III

H. W. BEARCE

In an article by J. Ed. Galbraith (*AM*—Vol. 78, p. 797), a rule was given for finding tap-drill size, the major diameter and threads per inch of the screw or bolt being known. The rule is simple and sufficiently exact for many purposes, especially for relatively large diameters and coarse pitches. But this rule gives the drill size to the nearest 64th of an inch. Obviously such an approximation is not sufficiently close for small diameters and fine pitches, since for threads finer than 40 per inch the full thread depth is less than $\frac{1}{64}$ inch.

A more exact rule, which is equally simple and applicable to all diameters and pitches, is that given by R. J. Owens, (*AM*—Vol. 56, page 935). This rule is also given in Marks *Mechanical Engineers Handbook*, but tap drill sizes given therein are not in agreement with the rule. This rule is: Subtract the pitch of the thread from the nominal diameter of the tap or screw. The remainder is the tap-drill size.

Application of this rule gives a depth of thread in the nut or tapped hole never less than 77 per cent of the basic thread depth, and also gives a depth of thread engagement between the tapped hole and the screw or bolt equal to 77 per cent of the basic thread depth, for screws and bolts of Classes 2, 3, and 4, when the major diameter of the screw or bolt is at the maximum (nominal) size. For Class 1 screws and bolts of maximum permissible major diameter the depth of engagement is 75 per cent of a full thread. For screws that are below the maximum major diameter, and within the N.S.T.C. tolerances for the various classes of fit, the percentage of thread engagement may drop to the following minimum values: Class 1, 60 per cent; Class 2, 62 per cent; Classes 3 and 4, 67 per cent. These values are well within the range of good commercial practice.

Uniform Pitch Thread Series

8-Pitch		12-Pitch				16-Pitch	
Nominal Size	Drill Size	Nominal Size	Drill Size	Nominal Size	Drill Size	Nominal Size	Drill Size
1″	$\frac{7}{8}$″	$\frac{1}{2}$″	0.417″	$3\frac{1}{4}$″	3.167	$\frac{3}{4}$″	$\frac{11}{16}$″
$1\frac{1}{8}$	1	$\frac{9}{16}$	0.479	$3\frac{1}{2}$	3.417	$\frac{7}{8}$	$\frac{13}{16}$
$1\frac{1}{4}$	$1\frac{1}{8}$	$\frac{5}{8}$	0.542	$3\frac{3}{4}$	3.667	1	$\frac{15}{16}$
$1\frac{3}{8}$	$1\frac{1}{4}$	$\frac{11}{16}$	0.604	4	3.917	$1\frac{1}{8}$	$1\frac{1}{16}$
$1\frac{1}{2}$	$1\frac{3}{8}$	$\frac{3}{4}$	0.667	$4\frac{1}{4}$	4.167	$1\frac{1}{4}$	$1\frac{3}{16}$
$1\frac{5}{8}$	$1\frac{1}{2}$	$\frac{13}{16}$	0.729	$4\frac{1}{2}$	4.417	$1\frac{3}{8}$	$1\frac{5}{16}$
$1\frac{3}{4}$	$1\frac{5}{8}$	$\frac{7}{8}$	0.792	$4\frac{3}{4}$	4.667	$1\frac{1}{2}$	$1\frac{7}{16}$
$1\frac{7}{8}$	$1\frac{3}{4}$	$\frac{15}{16}$	0.854	5	4.917	$1\frac{5}{8}$	$1\frac{9}{16}$
2	$1\frac{7}{8}$	1	0.917	$5\frac{1}{4}$	5.167	$1\frac{3}{4}$	$1\frac{11}{16}$
$2\frac{1}{8}$	2	$1\frac{1}{16}$	0.979	$5\frac{1}{2}$	5.417	$1\frac{7}{8}$	$1\frac{13}{16}$
$2\frac{1}{4}$	$2\frac{1}{8}$	$1\frac{1}{8}$	1.042	$5\frac{3}{4}$	5.667	2	$1\frac{15}{16}$
$2\frac{1}{2}$	$2\frac{3}{8}$	$1\frac{3}{16}$	1.104	6	5.917	$2\frac{1}{8}$	$2\frac{1}{16}$
$2\frac{3}{4}$	$2\frac{5}{8}$	$1\frac{1}{4}$	1.167	.....	.....	$2\frac{1}{4}$	$2\frac{3}{16}$
3	$2\frac{7}{8}$	$1\frac{5}{16}$	1.229	.....	.....	$2\frac{1}{2}$	$2\frac{7}{16}$
$3\frac{1}{4}$	$3\frac{1}{8}$	$1\frac{3}{8}$	1.292	.....	.....	$2\frac{3}{4}$	$2\frac{11}{16}$
$3\frac{1}{2}$	$3\frac{3}{8}$	$1\frac{7}{16}$	1.354	.....	.....	3	$2\frac{15}{16}$
$3\frac{3}{4}$	$3\frac{5}{8}$	$1\frac{1}{2}$	1.417	.....	.....	$3\frac{1}{4}$	$3\frac{3}{16}$
4	$3\frac{7}{8}$	$1\frac{5}{8}$	1.542	.....	.....	$3\frac{1}{2}$	$3\frac{7}{16}$
$4\frac{1}{4}$	$4\frac{1}{8}$	$1\frac{3}{4}$	1.667	.....	.....	$3\frac{3}{4}$	$3\frac{11}{16}$
$4\frac{1}{2}$	$4\frac{3}{8}$	$1\frac{7}{8}$	1.792	.....	.....	4	$3\frac{15}{16}$
$4\frac{3}{4}$	$4\frac{5}{8}$	2	1.917	.....	.....	.....	.....
5	$4\frac{7}{8}$	$2\frac{1}{4}$	2.167	.....	.....	.....	.....
$5\frac{1}{4}$	$5\frac{1}{8}$	$2\frac{1}{2}$	2.417	.....	.....	.....	.....
$5\frac{1}{2}$	$5\frac{3}{8}$	$2\frac{3}{4}$	2.667	.....	.....	.....	.....
$5\frac{3}{4}$	$5\frac{5}{8}$	3	2.917	.....	.....	.....	.....
6	$5\frac{7}{8}$	.....	.....	.....	.....	.....	.....

p = 0.1250 in. p = 0.0833 in. p = 0.0625 in.

National Coarse Thread Series

Nominal Size	Threads per in.	Major Diam.	Pitch	Drill Size*
1	64	0.073	0.0156	0.057
2	56	0.086	0.0179	0.068
3	48	0.099	0.0208	0.078
4	40	0.112	0.0250	0.087
5	40	0.125	0.0250	0.100
6	32	0.138	0.0312	0.107
8	32	0.164	0.0312	0.133
10	24	0.190	0.0417	0.148
12	24	0.216	0.0417	0.174
$\frac{1}{4}$	20	0.2500	0.0500	0.200
$\frac{5}{16}$	18	0.3125	0.0556	0.257
$\frac{3}{8}$	16	0.3750	0.0625	0.312
$\frac{7}{16}$	14	0.4375	0.0714	0.366
$\frac{1}{2}$	13	0.5000	0.0769	0.423
$\frac{9}{16}$	12	0.5625	0.0833	0.479
$\frac{5}{8}$	11	0.6250	0.0909	0.534
$\frac{3}{4}$	10	0.7500	0.1000	0.650
$\frac{7}{8}$	9	0.8750	0.1111	0.764
1	8	1.0000	0.1250	0.875
$1\frac{1}{8}$	7	1.1250	0.1429	0.982
$1\frac{1}{4}$	7	1.2500	0.1429	1.107
$1\frac{3}{8}$	6	1.3750	0.1667	1.208
$1\frac{1}{2}$	6	1.5000	0.1667	1.333
$1\frac{3}{4}$	5	1.7500	0.2000	1.550
2	$4\frac{1}{2}$	2.0000	0.2222	1.778
$2\frac{1}{4}$	$4\frac{1}{2}$	2.2500	0.2222	2.028
$2\frac{1}{2}$	4	2.5000	0.2500	2.250
$2\frac{3}{4}$	4	2.7500	0.2500	2.500
3	4	3.0000	0.2500	2.750
$3\frac{1}{4}$	4	3.2500	0.2500	3.000
$3\frac{1}{2}$	4	3.5000	0.2500	3.250
$3\frac{3}{4}$	4	3.7500	0.2500	3.500
4	4	4.0000	0.2500	3.750

*To nearest 0.001 in.

National Fine Thread Series

Nominal Size	Threads per In.	Major Diam.	Pitch	Drill Size*
0	80	0.060	0.0125	0.048
1	72	0.073	0.0139	0.059
2	64	0.086	0.0156	0.070
3	56	0.099	0.0179	0.081
4	48	0.112	0.0208	0.091
5	44	0.125	0.0227	0.102
6	40	0.138	0.0250	0.113
8	36	0.164	0.0278	0.136
10	32	0.190	0.0312	0.159
12	28	0.216	0.0357	0.180
$\frac{1}{4}$	28	0.2500	0.0357	0.214
$\frac{5}{16}$	24	0.3125	0.0417	0.271
$\frac{3}{8}$	24	0.3750	0.0417	0.333
$\frac{7}{16}$	20	0.4375	0.0500	0.388
$\frac{1}{2}$	20	0.5000	0.0500	0.450
$\frac{9}{16}$	18	0.5625	0.0556	0.507
$\frac{5}{8}$	18	0.6250	0.0556	0.569
$\frac{3}{4}$	16	0.7500	0.0625	0.688
$\frac{7}{8}$	14	0.8750	0.0714	0.804
1	14	1.0000	0.0714	0.929
$1\frac{1}{8}$	12	1.1250	0.0833	1.042
$1\frac{1}{4}$	12	1.2500	0.0833	1.167
$1\frac{3}{8}$	12	1.3750	0.0833	1.292
$1\frac{1}{2}$	12	1.5000	0.0833	1.417

IDEAS

FROM • PRACTICAL • MEN

Fixture for Grinding Threading Tools

MERTON W. SEAVEY

The fixture shown in general in Fig. 1 and in detail in Fig. 2 is the result of an attempt to develop a foolproof device for grinding toolbits for thread cutting.

Referring to Fig. 2, the member *A* for holding the toolbit has a bearing in the vertical part of the base and can be swiveled in a vertical plane for grinding the clearance angle on both sides of the toolbit, the amount of which depends upon the lead of the screw to be cut. The toolbit is located against the side and the top of one of the slots *B* and is clamped by setscrews. The slots are at an angle of 30 deg. to the center line, so that accuracy of the thread angle is built into the fixture.

After the toolbit has been ground on one side, using a saucer wheel, it is transferred to the slot in the opposite end, but on the same side of the holder for grinding the other side.

The clearance angle is read by the graduations at *C*. Since the top of the toolbit is radial with the center of rotation of the holder, the thread angle at the top of the toolbit is not changed in grinding the clearance angle. After the holder has been set to the clearance angle, it is locked by tightening the bearing cap.

The slots *D* at the back of the holder are at an angle of 29 deg. and are for holding toolbits to be ground for cutting Acme threads. When such toolbits are to be ground, the holder is swiveled 180 deg. to bring it into the grinding position.

The slots in the holder are for ½-in. square toolbits. When smaller toolbits are to be ground, packing is put underneath them to keep the tops in contact with the upper side of the slot.

In grinding new toolbits, time can be saved by rough grinding them to approximate shape by hand on a floor grinder and then finishing them on a surface grinder, holding them in the fixture.

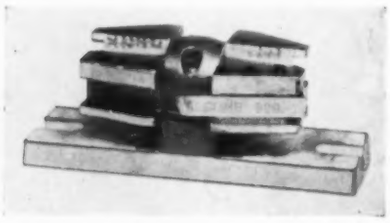


Fig. 1—The fixture can either be mounted on the table of a surface grinding machine or held on a magnetic chuck

Setting Tools Accurately Discussion

JOHN E. VAN KEUREN

Referring to the article by Matthew Harris under the title given above (*AM*—Vol. 78, page 748), a much simpler method could be used.

Place a 1-in. mandrel between the index centers. With a vernier height gage having an indicator attached, set the indicator to zero at the top of the mandrel and lower the height gage 0.500 in. The indicator will now read zero at the center height of the index centers from the table. Take the diameter of the spindle nose and raise the height gage one-half that amount. If the table is now raised or lowered until the indicator reads zero at the top of the spindle nose, the center line of the index centers will be at the center of the spindle.

By employing this method the index centers can be set to any amount above or below the center of the spindle. No special tools are required, as a vernier height gage and an indicator can be found in almost any shop, and the operation can be performed in two or three minutes.

Drilling a Hole Deeper Than the Length of the Drill

MALCOLM K. PARKHURST

Drilling a hole 7 in. deep with a drill only 5 in. long sounds something like a contradiction of terms. However, like lots of problems in the machine shop, the contradiction may be in term only, not in fact.

This specific nut to crack arose in drilling a ½-in. hole in a casting. The work was being done in the lathe with a straight-shank drill held in a chuck in the tailstock spindle. After drilling the hole as far as possible with the 5-in. drill, the drill was taken out and a slot wide enough for the blade of a husky screwdriver was milled across its shank. The screwdriver was held in the chuck that formerly held the drill and its blade was put in the slot in

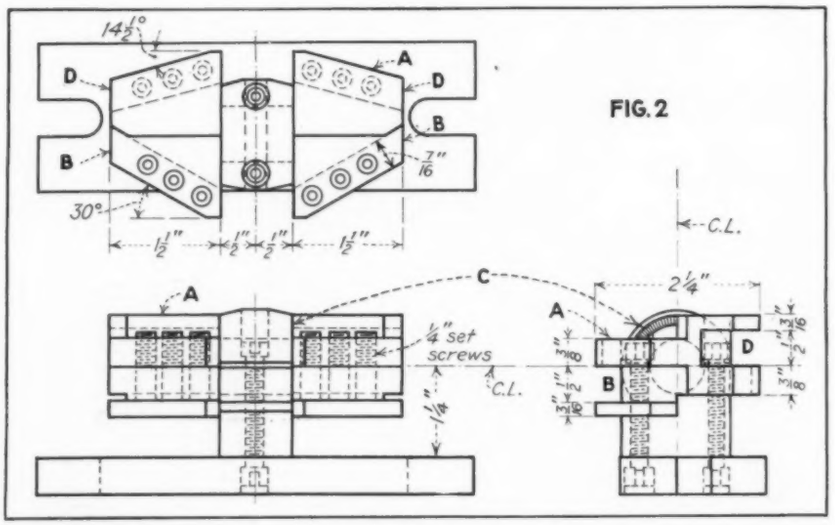


Fig. 2—The thread angle is built into the fixture. Provision is made for setting the holder to grind the clearance angles on both sides of the toolbit

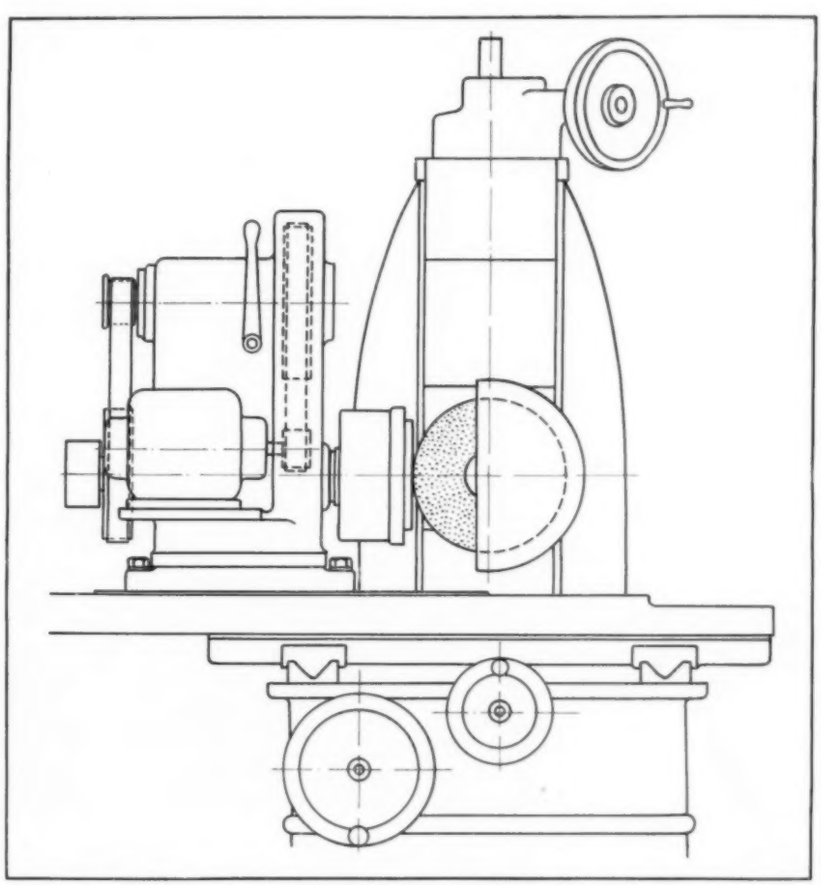
the drill. No trouble was experienced in keeping the screwdriver blade in the slot, and, of course, when the end of the drill shank had passed the surface of the work it was impossible for the screwdriver blade to slip out of the slot so long as pressure was applied.

Facing Disks on a Surface Grinder

LESTER J. LALIME

Occasionally a production job of face grinding comes along in a shop that has no equipment for the work. However, if the equipment includes a surface grinder, the problem can be solved by purchasing an independent, motor-driven headstock and mounting it on the machine table, as shown in the illustration.

The work can be held in a chuck, on a faceplate or on a rotary magnetic chuck. The longitudinal travel of the table is used to bring the work up to the grinding wheel and the cross feed is used to move the work back and forth past the face of the wheel.



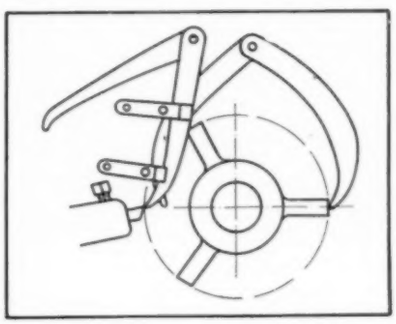
An independent, motor driven headstock mounted on the table of a surface grinder can be used for face grinding disks and other flat, round work

Calipering a Three-Point Diameter

H. MOORE
Hamilton, Ontario, Canada

Just lately I had to bore and turn a quantity of cast-iron bushings having three wings. How to caliper the outside diameter of the wings had me puzzled for awhile. Finally I reversed a pair of inside calipers and clamped one leg to the leg of a pair of outside calipers, as shown in the illustration.

Without moving the tool after a cut, one leg of the inside calipers was placed against the point of the tool and the opposite leg of the outside calipers was placed on one of the wings of the work. The illustration shows the scheme.



With inside and outside calipers clamped together as shown, it was an easy matter to caliper the wings of the bushings

Inspecting V-Blocks

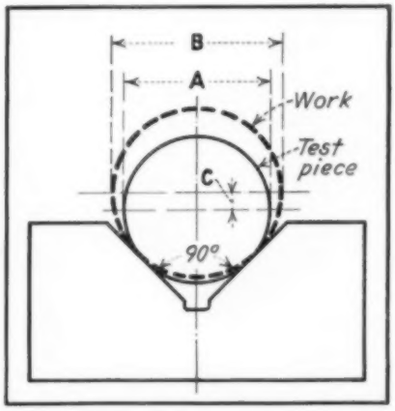
E. E. CRILLEY

In some fixtures, V-blocks are necessary for locating shafts or other round work having odd diameters due either to stock left for grinding or for some other reason.

In checking such V-blocks for holding work at the correct height in relation to other surfaces it is necessary to use cylindrical test pieces, but as such pieces of odd diameters are not always available, pieces of standard diameter can be used and the difference in center height between the test piece and that of the work can be found by using a simple formula in which C = the difference in center height between the test piece and that of the work; B = diameter of the work; and A = diameter of the test piece.

If the diameter of the test piece is less than that of the work, as shown in the illustration, the result of the formula $C = \frac{B-A}{2} \times$ sec. 45 deg. should be added to the center height of the test piece to find the center height the work will be held in the V-blocks.

If the diameter of the test piece is



V-blocks in fixtures can be checked for height with cylindrical test pieces differing in diameter from that of the work by application of a simple formula

greater than that of the work, the result of the formula $C = \frac{A - B}{2} \times \text{sec. } 45 \text{ deg.}$ should be subtracted from the center height of the test piece.

An Improved Sine Bar

A. F. PARKER

In toolrooms where gage blocks and other precision tools are seldom available, the men know how difficult it is to make the conventional sine bar illustrated in Fig. 1 to the close accuracy demanded in such a tool.

I have made several such sine bars having hardened and ground plugs pressed into ground holes in hardened bars, only to be disappointed in having the center distances of the plugs turn out to be somewhat more or less incorrect. The conclusion was then reached that some simpler and more accurate method and design could be devised.

It was decided to use as a model an accurate sine bar made by a manufacturer whose reputation for accurate tools is of the first order. The dimensions and design of this model sine bar were closely adhered to, the only exception being that the cylindrical pieces were longer than the thickness of the bar, as shown in Fig. 2, so that the sine bar could be set by a vernier height gage as well as by gage blocks, and in this consisted the improvement.

A bar of water quenching, high-carbon tool steel was cut to rough length and machined all over. After hardening, the bar was drawn in an oil bath at 350 deg. F., and was held at that temperature for about an hour, after which it was allowed to cool to room temperature while in the oil. To give it an aging treatment it was put out of doors at night and subjected to winter temperature. In the daytime it was brought indoors and placed on one of the shop radiators, this treatment being continued for about two months.

The bar was then finish ground square and parallel on all four sides and on the ends as well. The bearing surfaces *A* were then ground at one setting. In grinding the surfaces *B*, the bar was clamped to an accurate angle plate, using a dial indicator attached to the wheel head to insure the vertical setting.

We had the cylindrical pieces made by a manufacturer of piston pins who was equipped for grinding and lapping to limits within 0.0001 in., the work being done for less than we could have done it ourselves.

After attaching the cylindrical pieces to the bar, the assembly was mounted on the magnetic chuck of the surface grinder, the cylindrical pieces resting on the chuck, and surface *C* was then ground, being afterward lapped flat to a bright finish. The finished sine bar was recently checked by an optical measuring instrument at a room temperature of 70 deg. F. and was found to be within the required limit.

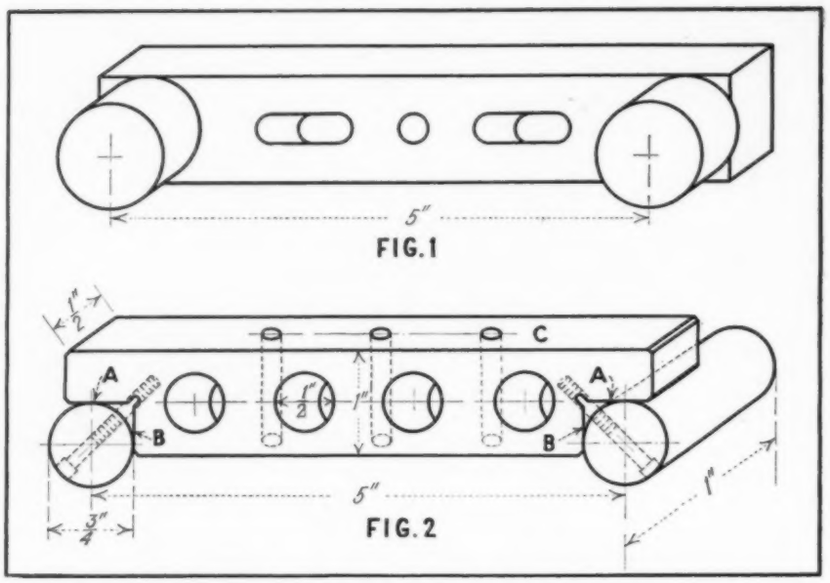


Fig. 1—A conventional sine bar. Fig. 2—The cylindrical pieces are longer than the thickness of the bar, permitting setting by a vernier height gage as well as by gage blocks

A Simple Section Liner Discussion

J. B. BOOTH
Bradford, Yorkshire, England

Referring to the section liner described by S. C. Dodge in an article under the title given above (*AM*—Vol. 78, page 748), I would like to point out that inaccuracies are very likely to result from using the series of small round holes.

I believe that a far better method would be to employ rectangular or square holes rather than round ones. Admitting the pencil point to a round hole and keeping it vertically parallel with the 45-deg. edge of the triangle is rather a difficult feat. Unless the pencil point is brought square with the edge of the triangle at each move, unequal spacings are sure to ensue. Given square or oblong holes, once the small point of the pencil is brought against the side of the hole it is positioned accurately.

The number and widths of these rectangular holes should be varied to cover a large range of section lining.

Extension Sleeve for a Ratchet Micrometer

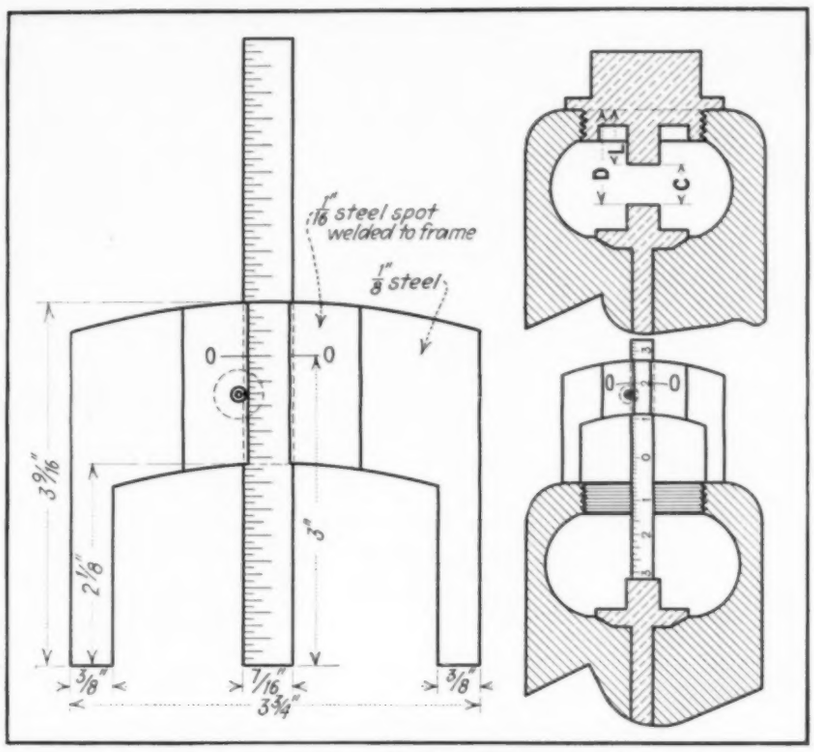
A. KENDALL
Hamilton, Ontario, Canada

When a 1-in. micrometer is opened half an inch or more, the ratchet is too far away to be reached easily by the thumb and finger of the hand holding the micrometer, so that both hands are usually required to operate it.

The operator on a production grinding job made a sleeve to fit over the thimble of his micrometer and attached it to the knurled stem of the ratchet by a setscrew, as shown in the illustration.

With the sleeve in place, no matter how much the micrometer is opened, the ratchet can be operated as illustrated, by grasping the sleeve near its inner end and turning it by the finger and thumb of the hand that holds the tool.

The outer end of the sleeve is attached to the knurled stem of the ratchet and can be easily turned by the thumb and finger of the hand that holds the micrometer



By applying a simple formula after reading the distance between the zero marks on the sliding scale and the gage frame, the depth of the cap can be found

A Special Depth Gage

J. J. THOMPSON

In making repairs to valves, such as locomotive pop valves, bypass valves, etc., it is often necessary to replace the valve proper or the cap, due to wear. In refitting the valves, care must be taken to provide a definite gap or clearance between the valve proper and the boss on the valve cap.

We have made several special depth gages for this class of work, by the use of which we can work to a fair standard of accuracy. The gage illustrated has a frame of ⅛-in. sheet steel upon which is mounted a sliding scale and a thumbnut to lock the scale. The scale is graduated in sixteenths of an inch on both sides of the zero mark, and the zero marks on both the scale and the frame coincide when the lower edge of the scale is even with the bottoms of the frame legs.

In use, the frame is placed over the valve body at the cap seat, the legs resting on the valve body. The lower end of the sliding scale is brought into contact with the upper end of the valve stem and is locked by the thumbnut. The reading is taken by noting the difference between the zero lines on the scale and the frame, use being made of the following simple formula: $L = D - C$, in which L = depth of cap; D = depth from top of cap seat to top of valve stem; and C = desired amount of clearance.

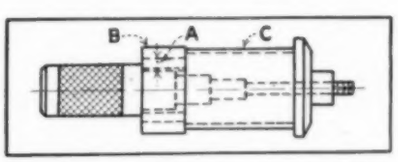
A Bushing Driver Discussion

JOHN E. HYLER

In an article under the title given above (*AM*—Vol. 79, page 54), C. F. Fitz describes a bushing driver having steps of different diameters. While this tool has considerable merit, in that it can be used for driving bushings of various sizes, I think it can be improved upon to make it adaptable to work where one does not want to use a hammer, or that would be difficult to take to a press.

An improvement would be to make the small end much longer, thread it and fit it with a nut and a heavy washer, as shown in the illustration. A housing from which the bushing *A* is to be withdrawn is roughly indicated at *B*. The driver is put through the bushing and the piece of pipe *C* is put over it, butting against the housing. The washer is put against the outer end of the pipe and the nut is screwed on. Tightening the nut will draw the bushing out of the housing and into the pipe.

To avoid making the small end of the driver abnormally long, shorter pieces of pipe are used when drawing bushings into place, or withdrawing bushings that are smaller than the largest shoulder of the driver.



Bushings of different sizes can be drawn in or out with this tool without the use of a hammer or taking the work to a press

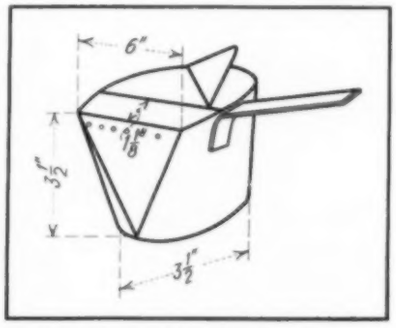
A Welded Ladle for Pouring Solder

A. EYLES
St. Albans, Hertfordshire, England

While there are many types of ladles for pouring solder that are made from stampings and cast and malleable iron, the sheet-steel ladle with welded joints shown will be found very useful for pouring solder strips in quantity.

The ladle body is fabricated from mild sheet-steel ⅛ in. thick, and the parts are welded together by a gas torch. The handle is a piece of 1x¼-in. iron about 16 in. long. The metal strip at the top prevents the molten solder from overflowing while pouring and keeps back the dross and foreign matter, so that it is self skimming.

In use, the ladle is filled with molten solder to the height of the six, ⅞ inch holes. It is tilted slightly to permit the solder to flow through the holes as it is drawn over a suitable iron plate, leaving behind it six strips of solder from ⅞ to ⅜ in. wide and from 10 to 12 ft. long. The solder cools as it touches the iron plate, making strips fit for immediate use.



The molten solder flowing through holes and on to an iron plate leaves six strips ready for use

SHOP EQUIPMENT NEWS

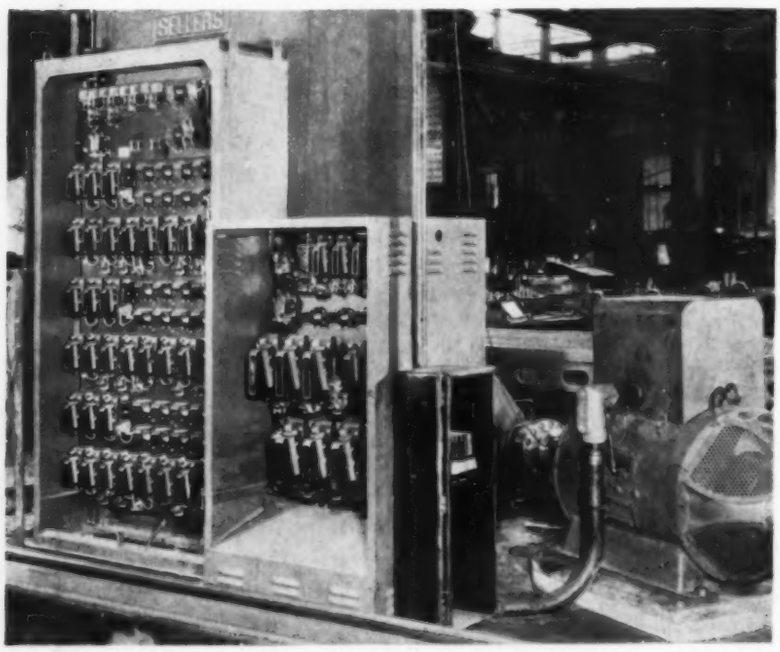
Sellers Completely Electrified Openside Planer

Wm. Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa., now offers an advanced design for openside planers of 60 in. size and larger. Close cooperation between the engineers of the Sellers Company and the Westinghouse Electric & Manufacturing Company has resulted in a planer that is the most completely electrified machine of its type yet built. Many recent advances in machine tool electrification are embodied. Individual motor drives and automatic electrical control devices have made possible considerable advances in simplicity, accessibility, safety, convenience of operation, and appearance. Simplicity is gained by the use of individual motors for each head, the platen, rail elevating, clamp and lubricating pump drives. The design is free and clean from unsightly projections. There are no operating levers except those required for hand motions. All control is by means of built-in push buttons and switches. All bolts, except those used for clamping tools and for adjusting and clamping the heads, are of the socket head type and are set into counterbores.

The bed and table are deep and heavy sections. Drive from the motor to the table is by the company's spiral pinion, rack and one pair of helical gears. Thrust on the drive shaft is taken on anti-friction bearings arranged so that no change in temperature will affect the adjustment. Tableways have automatic lubrication by a separate motor-driven pump that supplies filtered oil at two places in each way. The driving motor, rated at 100 hp. at 40 ft. per minute and above, has a 10 to 1 speed range and provides cutting speeds of 20 to 200 ft. per min. This wide-speed-range motor makes possible the use of very slow cutting speeds with high return speeds and is desirable for the use of tungsten carbide or high-speed cutting tools.

The housing is made of the same width and depth all the way to the top to provide rigidity when the crossrail is in the higher positions. It is tied into the bed with a large cheek of great depth and width. The width of face of the housing on which the side head travels is 21 in. The depth, front to back, is 79 in. Because of the small amount of room required for the cross-rail mechanism, the face is well backed up with the wall of the housing and it was not necessary to neck it down. The crossrail is made in two pieces, the front face upon which the heads travel and the rear brace of welded steel which supports the front face. The two pieces are bolted and doweled together with provision for realignment if necessary.

Powerful clamps operated by a torque motor through toggle mechanism hold the rail to the housing. The clamps are so arranged that they pull the rail back against the housing face as well as hold it securely in proper alignment. When the clamps are released the weight of the rail and the brace are taken on a hardened steel block on the outside lip of the housing face. This block has a ball seat providing equal distribution of pressure over the entire surface.



Heavy-duty magnetic control panels such as these afford fast, convenient and safe operation of the Sellers openside planer. Left-hand panel controls feeds, rapid traverse, crossrail lift and clamp. Adjacent cabinet has controls for the main drive motor

Crossrail Control

The cross-rail elevating push buttons are located on the end of the crossrail. The crossrail elevating and crossrail clamp motors are interlocked and arranged to be operated from the same push button. When one of these is depressed it first causes the clamp motor to start in the proper direction for unclamping. After the clamp is released the crossrail elevating motor is started automatically, causing the rail to move up or down depending upon which push button is selected. When the push button is released the crossrail motor is stopped by dynamic braking and the clamp motor is caused to operate.

AMERICA

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Production Equipment	First District		Second District		Third District		
	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total U Now Plac
Bending Machines							
Brakes	390	245	847	413	743	490	1,
Rolls	1,025	814	1,436	961	1,367	1,109	3,
Straightening	400	353	1,105	372	350	287	
Other	344	167	839	515	507	307	1,
Boring Machines							
Horizontal	1,396	940	1,650	1,153	2,588	2,172	3,
Vertical	2,231	1,833	5,454	4,633	5,243	4,509	4,
Jig	160	24	131	23	269	207	
Other	133	81	226	165	152	7	
Broaching Machines	671	555	390	308	785	745	
Cutting-off Machines							
Band-saw	844	647	1,386	857	984	672	2,
Rotary cold saw	1,236	892	1,276	875	719	505	1,
Hack-saw	2,661	1,852	3,053	2,212	1,424	731	3,
Abrasive disk	203	86	335	162	346	126	
Other	428	277	527	191	542	350	
Drilling Machines							
Horizontal:							
Single-spindle	660	571	1,612	1,070	1,161	948	1,
Multiple-spindle	494	350	664	335	275	273	1,
Vertical:							
Multiple-spindle	2,558	1,713	3,155	2,352	1,331	855	3,
Standard (upright)	7,412	5,609	7,914	6,416	4,470	3,596	10,
Sensitive:							
Single-spindle	4,562	3,804	3,836	2,760	2,075	1,493	4,
Multiple-spindle	2,817	1,864	2,562	982	1,170	846	4,
Radial	2,948	1,894	2,805	2,064	4,775	3,374	5,
2, 3, 4 or 5 way	341	256	204	121	191	129	
Centering machines	549	478	379	344	261	215	
Other	633	424	2,400	1,593	336	209	1,
Honing Machines	99	11	121	3	117	8	
Forging Machines							
Hammers							
Drop	959	916	411	370	430	257	1,
Steam or air operated	557	460	784	722	1,342	993	1,
Other power	623	555	291	239	298	270	1,
Forging presses, hydraulic	599	587	1,366	938	942	879	
Hot forging machines	365	336	231	191	223	223	2,
Cold forging machines	165	64	25	8	17	13	
Swaging machines	277	185	227	128	342	153	
Other	255	177	49	39	45	35	
Gear-Cutting Machines							
Formed rotary-cutter type:							
Spur and helical	1,353	1,193	1,110	914	351	336	2,
Bevel	886	328	152	145	12	10	
Generators							
Shapers (Fellows-type)	1,150	653	519	309	287	260	1,
Bevel, spiral bevel and hypoid	830	466	291	160	48	43	
Herringbone			585	195	3	3	
Hobbing	786	481	1,729	1,299	261	155	2,
Shaving and finishing	2,356	1,428	16	8	13	7	
Other	65	65	384	355	45	38	
Grinding Machines							
Cutter and tool	5,824	3,993	7,662	5,444	4,961	2,987	6,
Drill	868	435	958	756	616	288	1,
Floor	4,341	3,121	3,344	2,450	4,897	3,016	7,
Bench	2,366	1,649	1,531	722	783	524	2,
Disk	1,005	719	1,080	646	810	340	1,
External cylindrical, plain and universal	4,487	3,250	2,362	1,526	6,433	3,192	6,
Internal cylindrical	1,927	754	1,190	693	2,175	1,116	1,
Surface, horizontal and vertical	4,221	2,594	3,763	1,903	1,866	1,003	3,
Centerless	336	134	248	73	410	10	1,
Other	2,878	1,430	1,452	969	830	420	1,

MERICAN MACHINIST 1935 Inventory

By the Twelve Federal Reserve Districts

Third District		Fourth District		Fifth District		Sixth District		Seventh District		Eighth District		Ninth District	
Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old
743	490	1,633	1,118	397	246	120	114	3,772	1,884	532	293	531	309
1,367	1,109	3,060	2,169	878	628	75	70	3,603	2,656	264	200	445	218
350	287	986	743	149	111	33	.....	1,007	675	.....	.....	33	33
507	307	1,205	751	644	529	39	34	2,941	2,238	289	91	40	12
2,588	2,172	3,396	2,188	276	196	94	69	4,129	2,584	72	52	70	66
5,243	4,509	4,313	3,396	868	491	113	34	4,131	2,842	103	90	214	201
269	207	199	16	4	.....	.....	.....	233	27	15	.....	3	3
152	7	81	49	35	35	.....	.....	275	147	.....	.....	.....	.....
785	745	524	338	53	8	.....	.....	2,577	1,294	5	.....	48	18
984	672	2,997	1,660	381	295	50	38	3,626	2,417	114	75	87	77
719	505	1,367	897	288	206	59	53	1,957	1,291	57	27	109	73
1,424	731	3,848	2,719	538	352	201	182	5,812	4,087	380	264	274	251
346	126	493	326	37	37	5	5	1,840	1,514	5	5	.....	.....
542	350	731	410	346	325	7	7	1,857	1,447	12	.....	53	25
1,161	948	1,318	910	57	51	28	28	3,589	2,647	29	29	387	256
275	273	1,106	383	29	10	56	.....	2,785	1,354	10	10	47	9
1,331	855	3,812	2,188	445	302	64	53	11,171	6,878	241	182	175	110
4,470	3,596	10,856	6,187	1,799	1,410	706	540	41,336	25,033	1,147	525	685	526
2,075	1,493	4,890	3,709	514	377	178	107	6,408	3,537	785	183	259	107
1,170	846	4,111	3,158	61	48	5	.....	2,859	1,254	709	70	20	.....
4,775	3,374	5,286	3,558	2,094	1,426	183	126	8,359	5,651	129	98	233	177
191	129	194	139	70	56	112	73	778	280	19	7	17	17
261	215	899	723	166	137	68	68	1,376	966	40	6	34	28
336	209	1,389	806	39	32	64	59	2,507	505	100	44	41	35
117	8	508	239	9	2	7	7	472	244	3	.....	.....	.....
430	257	1,062	858	318	290	8	8	1,035	912	131	75	210	210
1,342	993	1,361	1,110	358	338	168	161	1,469	1,320	36	36	81	74
298	270	1,183	766	127	90	78	78	1,336	1,114	40	37	3	3
942	879	759	668	289	227	.....	.....	1,033	757	99	71	19	19
223	223	2,247	996	222	213	40	27	1,067	804	135	128	62	62
17	13	130	118	.....	.....	.....	.....	63	58	28	28	.....	.....
342	153	362	199	279	56	.....	.....	830	449	40	9	35	35
45	35	130	102	126	114	18	18	410	80	.....	.....	71	58
351	336	2,007	1,429	52	24	3	3	2,306	1,516	14	14	57	29
12	10	771	698	.....	.....	.....	.....	487	335	8	8	5	5
287	260	1,004	787	341	65	.....	.....	3,301	2,056	55	49	24	16
48	43	691	525	.....	.....	.....	.....	1,244	971	.....	.....	5	5
3	3	64	.....	.....	.....	.....	.....	35	.....	.....	.....	.....	.....
261	155	2,069	1,414	69	41	3	.....	4,443	2,035	18	14	8	8
13	7	178	36	.....	.....	.....	.....	676	526	.....	.....	.....	.....
45	38	276	100	28	28	.....	.....	63	23	.....	.....	73	73
4,961	2,987	6,858	4,602	878	588	253	221	9,355	4,713	226	184	371	301
616	288	1,520	935	214	129	95	85	2,038	1,267	124	71	137	103
4,897	3,016	7,777	4,783	1,590	1,245	654	541	17,883	11,017	588	281	782	611
783	524	2,321	1,428	567	427	166	63	5,148	1,742	365	144	169	113
810	540	1,547	1,004	85	32	90	76	3,834	2,364	42	26	88	52
6,433	3,192	6,059	3,984	310	146	31	31	9,276	6,974	67	58	26	26
2,175	1,116	1,635	496	168	92	25	12	3,444	1,960	3	3	21	21
1,866	1,003	3,097	1,624	365	284	25	18	6,422	3,657	138	31	97	97
410	10	1,237	105	.....	.....	.....	.....	1,374	357	6	.....	.....	.....
						74	26	1,628	938	23	23	20	20

Centerless												
Other	336	134	248	73	410	10	1,23					
	969	830	420	1,52								

# of Metal-Working Equipment

Plant-Service and Miscellaneou

	Tenth District		Eleventh District		Twelfth District	
	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old
	332	152	13	13	1,166	705
	636	336	27	27	1,467	1,040
	63	35	7	7	29	16
	99	68	17	12	573	292
	121	71	22	17	319	202
	308	271	39	39	519	298
					17	11
	13	7			189	52
	28	28			64	58
	178	33	12	5	368	249
	78	41	7	7	172	58
	297	194	10		936	502
	47	37	10		70	36
	38	30			230	53
	49	35			450	166
	2				522	179
	74	2	10	5	662	345
	1,017	813	113	91	2,664	1,902
	127	112	10	10	785	428
	111	111			214	165
	414	372	19	15	987	531
	38	17			51	25
	60	55	22	17	46	44
	48	7			356	159
					49	2
	2	2	7	7	218	70
	231	225	30	30	245	219
	44	31			41	8
	37	9	13	13	63	35
	86	74	13	13	35	28
	40	40			7	7
	13	13	7	7	9	3
	4	4			39	35
	184	175	10	5	239	208
	33	5	12	7	4	4
	28	28	10	10	162	140
	61	28			204	195
	14	5	5		220	194
	275	249	75	60	1,428	578
	165	117	22	17	475	204
	863	611	80	78	1,340	984
	157	114	5	5	514	280
	61	40			167	122
	203	142			295	140
	51	46			162	90
	118	90	12	7	174	136
					19	17
	31	31			103	52

	Total Units Now in Place	More 10 Y O
Heat-Treating and Hardening Furnaces		
Gas	20,762	12
Oil	16,135	11
Electric	8,27	2
Plating Equipment		
Tanks	12,187	6
Machines	2,606	
Motor-generator sets	3,631	1
Finishing Equipment		
Baking and Drying Ovens:		
Gas	3,781	2
Oil	1,362	1
Electric	3,634	1
Portable Tools		
Drills:		
Electric	51,848	1
Pneumatic	55,638	3
Grinders:		
Electric	16,095	
Pneumatic	22,022	
Hammers (chipping, riveting, calking)		
Electric	2,285	
Pneumatic	73,047	3
Other portable tools	6,173	
Flexible-shaft machines	5,317	
Portable Welding Outfits		
Electric	7,206	
Gas	9,558	
Spraying Systems	10,804	
Sand Blast Equipment	7,562	
Tumbling Barrels	28,061	1
Pickling Machines	1,325	
Drying Machines	868	
Parts Washing Machines	3,396	
Oil Extracting Machines (from chips)	2,275	
Air Compressors	20,519	1
Fans & Blowers (not built into ovens)	48,554	2
Hoists		
Chain, hand	79,559	
Electric	25,874	
Pneumatic	14,640	
Cranes		
Jib, hand	39,498	
Jib, electric	10,407	
Overhead traveling	46,823	
Monorail or tramrail	10,511	
Trucks and Tractors		
Power lift	6,537	
Power elevating or tiering	1,885	
Other power	5,435	
Hand	178,628	
Total for Metal-Working Industry	897,775	46

1935 Inventory of Metal-Working Equi

e Districts

Seventh District		Eighth District		Ninth District		Tenth District		Eleventh District		Twelfth District	
Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old
3,772	1,884	532	293	531	309	332	152	13	13	1,166	705
3,603	2,656	264	200	445	218	636	336	27	27	1,467	1,040
1,007	675	.....	.....	33	33	63	35	7	7	29	16
2,941	2,238	289	91	40	12	99	68	17	12	573	292
4,129	2,584	72	52	70	66	121	71	22	17	319	202
4,131	2,842	103	90	214	201	308	271	39	39	519	298
233	27	15	.....	3	3	.....	.....	.....	.....	17	11
275	147	.....	.....	.....	.....	13	7	.....	.....	189	52
2,577	1,294	5	.....	48	18	28	28	.....	.....	64	58
3,626	2,417	114	75	87	77	178	33	12	5	368	249
1,957	1,291	57	27	109	73	78	41	7	7	172	58
5,812	4,087	380	264	274	251	297	194	10	.....	936	502
1,840	1,514	5	5	.....	.....	47	37	10	.....	70	36
1,857	1,447	12	.....	53	25	38	30	.....	.....	230	53
3,589	2,647	29	29	387	256	49	35	.....	.....	450	166
2,785	1,354	10	10	47	9	2	.....	.....	.....	522	179
11,171	6,878	241	182	175	110	74	2	10	5	662	345
41,336	25,033	1,147	525	685	526	1,017	813	113	91	2,664	1,902
6,408	3,537	785	183	259	107	127	112	10	10	785	428
2,859	1,254	709	70	20	.....	111	111	.....	.....	214	165
8,359	5,651	129	98	233	177	414	372	19	15	987	531
778	280	19	7	17	17	38	17	.....	.....	51	25
1,376	966	40	6	34	28	60	55	22	17	46	44
2,507	505	100	44	41	35	48	7	.....	.....	356	159
472	244	3	.....	.....	.....	.....	.....	.....	.....	49	2
1,035	912	131	75	210	210	2	2	7	7	218	70
1,469	1,320	36	36	81	74	231	225	30	30	245	219
1,336	1,114	40	37	3	3	44	31	.....	.....	41	8
1,033	757	99	71	19	19	37	9	13	13	63	35
1,067	804	135	128	62	62	86	74	13	13	35	28
63	58	28	28	.....	.....	40	40	.....	.....	7	7
830	449	40	9	35	35	13	13	7	7	9	3
410	80	.....	.....	71	58	4	4	.....	.....	39	35
2,306	1,516	14	14	57	29	184	175	10	5	239	208
487	335	8	8	5	5	33	5	12	7	4	4
3,301	2,056	55	49	24	16	28	28	10	10	162	140
1,244	971	.....	.....	5	5	61	28	.....	.....	204	195
35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4,443	2,035	18	14	8	8	14	5	5	.....	220	194
676	526	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
63	23	.....	.....	73	73	.....	.....	.....	.....	.....	.....
9,355	4,713	226	184	371	301	275	249	75	60	1,428	578
2,038	1,267	124	71	137	103	165	117	22	17	475	204
17,883	11,017	588	281	782	611	863	611	80	78	1,340	984
5,148	1,742	365	144	169	113	157	114	5	5	514	280
2,830	2,364	42	26	88	52	61	40	.....	.....	167	122
9,276	6,974	67	58	26	26	203	142	.....	.....	295	140
3,444	1,960	3	3	21	21	51	46	.....	.....	162	90
6,422	3,657	138	31	97	97	118	90	12	7	174	136
1,334	357	6	.....	.....	.....	.....	.....	.....	.....	19	17
1,623	938	23	23	20	20	31	31	.....	.....	103	52
								19	15	270	191

ipment

Plant-Service and Miscellaneous Equipment

	Total Units Now in Place	More Than 10 Years Old	Per Cent over 10 Years Old
Heat-Treating and Hardening Furnaces			
Gas	20,762	12,969	62
Oil	16,135	11,260	70
Electric	8,927	2,425	27
Plating Equipment			
Tanks	12,187	6,021	49
Machines	2,606	585	22
Motor-generator sets	3,631	1,952	54
Finishing Equipment			
Baking and Drying Ovens:			
Gas	3,781	2,039	54
Oil	1,362	1,077	79
Electric	3,634	1,045	29
Portable Tools			
Drills:			
Electric	51,848	18,252	35
Pneumatic	55,638	32,282	58
Grinders:			
Electric	16,095	6,565	41
Pneumatic	22,022	4,615	21
Hammers (chipping, riveting, calking)			
Electric	2,285	807	35
Pneumatic	73,047	37,038	51
Other portable tools	6,173	1,922	31
Flexible-shaft machines	5,317	1,762	33
Portable Welding Outfits			
Electric	7,206	1,672	23
Gas	9,558	3,352	35
Spraying Systems	10,804	2,962	27
Sand Blast Equipment	7,562	3,640	48
Tumbling Barrels	28,061	18,938	67
Pickling Machines	1,325	678	51
Drying Machines	868	348	40
Parts Washing Machines	3,396	1,087	32
Oil Extracting Machines (from chips)	2,275	1,253	55
Air Compressors	20,519	12,464	61
Fans & Blowers (not built into ovens)	48,554	25,753	53
Hoists			
Chain, hand	79,559	54,192	68
Electric	25,874	11,986	46
Pneumatic	14,640	8,654	59
Cranes			
Jib, hand	39,498	29,415	74
Jib, electric	10,407	7,203	69
Overhead traveling	46,823	37,773	81
Monorail or tramrail	10,511	5,013	48
Trucks and Tractors			
Power lift	6,537	2,922	45
Power elevating or tiering	1,885	791	42
Other power	5,435	2,669	49
Hand	178,628	90,785	51
Total for Metal-Working Industry	897,775	466,166	52

Foundry Equipment

Disk	1,003	719	1,086	648	810	540	1,347
External cylindrical, plain and universal	4,487	3,250	2,362	1,326	6,433	3,192	6,059
Internal cylindrical	1,927	754	1,190	693	2,175	1,116	1,635
Surface, horizontal and vertical	4,221	2,594	3,763	1,903	1,866	1,003	3,097
Centerless	336	134	248	73	410	10	1,237
Other	2,878	1,430	1,452	969	830	420	1,527
Keyseaters	653	504	622	459	614	497	1,771
Lapping Machines	261	137	422	266	174	44	221
Lathes							
Bench	3,457	2,625	2,516	1,690	3,937	2,860	2,434
Engine (including toolroom)	22,301	16,109	21,447	17,903	12,748	9,131	20,230
Automatic multiple-spindle	4,338	2,633	3,473	1,659	2,027	1,588	4,383
Automatic single-spindle	5,476	2,547	2,911	1,088	1,521	1,009	4,381
Wheel and axle (R.R.)	444	415	145	92	512	386	1,078
Turret							
Ram type	3,582	2,265	3,441	2,684	1,827	1,179	7,604
Saddle type	3,489	2,429	5,619	4,064	4,060	3,118	5,604
Other	5,494	3,614	4,032	3,297	1,178	605	2,474
Milling Machines							
Hand (no power feed)	2,539	2,215	1,518	1,253	475	379	1,958
Plain	6,916	4,915	7,664	5,840	2,920	1,925	5,514
Universal	3,213	2,501	2,738	2,070	1,903	1,359	3,225
Vertical	1,685	1,183	1,176	965	1,242	7,521	1,952
Planer type	648	430	340	276	431	330	1,067
Lincoln type	626	532	62	52	668	496	566
Continuous (including rotary)	107	67	70	55	85	43	266
Other	1,573	1,347	532	325	281	177	749
Planers							
Standard	3,994	3,634	3,156	2,854	3,266	2,384	4,089
Open-side	268	192	115	78	428	307	792
Pipe Cutting and Threading Machines	755	430	767	577	2,306	1,358	1,676
Polishing and Buffing Machines							
Abrasive wheel	3,110	2,730	3,503	2,414	2,103	1,261	3,662
Abrasive belt	683	395	434	262	952	499	410
Automatic	432	69	399	197	1,022	491	255
Presses (not forging presses)							
Arbor	5,145	3,947	3,826	2,504	2,454	1,552	3,495
Crank type	3,131	2,728	1,883	864	1,545	1,161	7,470
Toggle type	2,218	1,527	2,896	1,418	154	80	1,540
Punch	8,067	6,481	12,138	9,354	4,468	2,972	19,600
Other	5,242	1,672	1,033	328	971	678	3,310
Riveting Machines (not portable)	884	655	2,288	753	712	502	3,450
Shapers							
Horizontal	3,602	3,021	3,875	3,048	2,611	1,887	5,960
Vertical			632	360	99	55	220
Shears							
Hand	226	135	1,880	1,359	538	296	2,840
Power	710	709	1,877	1,219	2,116	1,199	4,360
Slotters	432	312	1,053	923	2,103	1,184	1,120
Threading Machines (except for pipe)							
Hobbing and milling	2,097	991	2,406	412	741	288	990
Die type	706	555	1,213	1,096	676	484	1,690
Tapping	1,034	673	1,504	924	471	266	3,450
Welding and Cutting Machines							
Electric arc	755	193	1,722	833	2,746	295	3,960
Gas	339	117	467	166	603	144	990
Resistance	222	35	2,046	534	707	155	3,150
Other Machine Tools	983	578	2,414	833	3,942	2,132	1,620
Totals by Federal Reserve Districts	**186,511**	**129,960**	**188,328**	**129,430**	**134,958**	**95,211**	**252,800**
Per Cent Over 10 Years Old	**70**		**69**		**71**		
Per Cent of Total Equipment in Each Reserve District	**13.9**		**14.0**		**10.1**		

	810	340	1,547	1,004	85	32	30	31	2,021	2,501	42	26	66	
5	6,433	3,192	6,059	3,984	310	146	31	31	9,276	6,974	67	58	26	
93	2,175	1,116	1,635	496	168	92	25	12	3,444	1,960	3	3	21	
03	1,866	1,003	3,097	1,624	365	284	25	18	6,422	3,657	138	31	97	
73	410	10	1,237	105	.....	.....	.....	.....	1,374	357	6	.....	.....	
969	830	420	1,527	877	184	122	74	26	1,628	938	23	23	20	
459	614	497	1,771	1,406	303	166	76	74	1,381	1,095	85	73	100	
266	174	44	221	128	7	.....	.....	.....	900	241	5	5	.....	.....
690	3,937	2,860	2,434	1,928	387	270	5	5	4,664	3,313	117	39	247	
903	12,748	9,131	20,230	15,119	3,463	2,494	987	891	38,504	27,626	961	661	1,339	1
659	2,027	1,588	4,383	2,281	176	80	.....	.....	10,772	5,419	106	6	30	
088	1,521	1,009	4,381	3,103	285	94	.....	.....	7,090	3,683	316	136	77	
92	512	386	1,078	973	171	111	79	66	1,027	724	46	40	120	
684	1,827	1,179	7,604	5,250	62	45	86	86	9,052	6,280	189	158	209	
064	4,060	3,118	5,604	3,592	594	310	114	79	8,421	5,341	261	224	481	
297	1,178	605	2,474	2,211	130	20	.....	.....	3,045	1,996	119	116	267	
253	475	379	1,958	1,508	48	33	5	5	5,925	3,989	204	160	299	
840	2,920	1,925	5,514	3,661	541	460	23	21	14,119	7,953	137	89	188	
070	1,903	1,359	3,225	2,457	337	262	122	115	4,525	3,090	89	55	91	
965	1,242	7,521	1,952	1,152	100	48	18	18	2,794	1,666	128	33	46	
276	431	330	1,067	788	167	58	26	13	1,179	823	20	20	27	
52	668	496	566	516	8	8	.....	.....	1,256	1,070	20	17	6	
55	85	43	266	136	.....	.....	.....	.....	765	378	.....	.....	13	
325	281	177	749	504	93	93	7	7	1,153	579	33	5	20	
854	3,266	2,384	4,089	3,622	656	599	244	220	4,372	3,926	200	159	222	
78	428	307	797	537	120	120	.....	.....	459	347	22	18	14	
577	2,306	1,358	1,676	968	358	203	212	186	1,904	1,429	163	105	117	
414	2,103	1,261	3,667	1,990	208	169	15	15	6,349	3,091	486	177	164	
262	952	499	410	172	41	28	7	7	1,358	295	7	7	13	
197	1,022	491	255	222	127	56	.....	.....	1,238	874	34	28	.....	.....
504	2,454	1,552	3,495	2,252	476	315	16	13	13,592	5,958	100	40	262	
864	1,545	1,161	7,470	5,956	5,428	4,755	33	20	9,870	2,830	334	223	122	
418	154	80	1,540	1,090	124	111	10	.....	1,573	655	.....	.....	28	
354	4,468	2,972	19,601	14,453	8,183	7,119	74	51	30,112	17,110	1,093	402	1,970	1,
328	971	678	3,317	2,182	241	104	179	166	5,417	3,172	103	97	161	
753	712	502	3,457	2,321	685	596	22	18	8,210	3,112	365	71	176	
048	2,611	1,887	5,969	4,345	805	660	186	138	7,884	5,495	385	276	366	
360	99	55	221	114	44	37	31	31	485	270	6	.....	86	
359	538	296	2,846	2,032	476	357	126	96	1,950	1,402	522	272	330	
219	2,116	1,199	4,365	3,188	3,244	2,735	281	172	6,746	4,620	564	272	602	
923	2,103	1,184	1,179	1,053	142	129	77	71	905	733	30	18	75	
412	741	288	998	681	8	8	.....	.....	907	493	5	5	26	
096	676	484	1,692	1,245	453	416	111	91	2,766	1,764	139	132	118	
924	471	266	3,459	2,422	94	82	39	5	3,393	1,792	118	68	91	
833	2,746	295	3,969	1,445	725	91	229	43	8,427	1,662	113	13	170	
166	603	144	975	463	787	.....	9	.....	1,785	915	67	31	316	
534	707	155	3,159	1,659	768	266	5	5	2,312	502	355	13	262	
833	3,942	2,132	1,645	1,165	49	.....	14	14	1,493	689	31	31	.....	.....
30	134,958	95,211	252,802	172,714	47,843	35,369	7,466	5,777	439,619	259,799	15,324	7,836	15,420	10,7
	71		68		74		77		59		51		70	
	10.1		18.8		3.6		0.6		32.3		1.2		1.2	

26	26	203	142	.....	.....	295	140
21	21	51	46	.....	.....	162	90
97	97	118	90	12	7	174	136
.....	.....	.....	.....	.....	.....	19	17
20	20	31	31	.....	.....	103	52
100	65	218	154	19	15	270	191
.....	.....	5	5	.....	.....	201	9
247	101	195	167	4	4	360	258
1,339	1,242	1,938	1,482	171	147	3,334	2,110
30	23	130	117	.....	.....	108	40
77	70	94	94	.....	.....	276	236
120	120	88	61	30	30	116	116
209	181	124	108	20	20	454	297
481	448	571	358	17	15	510	298
267	239	56	56	.....	.....	250	48
299	45	147	147	.....	.....	178	105
188	141	109	102	22	22	447	286
91	57	276	190	12	7	591	351
46	46	.....	.....	5	5	285	157
27	22	23	14	2	2	42	29
6	6	28	.....	.....	.....	205	203
13	7	5	.....	.....	.....	38	4
20	20	.....	.....	.....	.....	151	80
222	218	359	311	49	44	274	266
14	5	12	9	.....	.....	67	61
117	83	108	57	42	37	655	315
164	98	203	89	.....	.....	551	380
13	13	2	.....	.....	.....	71	5
.....	.....	.....	.....	.....	.....	62	30
262	179	115	28	22	17	919	528
122	39	669	669	13	13	666	430
28	28	104	56	.....	.....	140	53
,970	1,265	361	175	12	12	1,233	674
161	140	206	152	10	5	780	367
176	42	125	61	.....	.....	327	271
366	217	538	374	28	28	709	483
86	73	58	51	.....	.....	11	11
330	262	159	102	19	15	1,186	700
602	342	429	207	30	30	1,177	867
75	75	74	69	7	7	33	24
26	26	33	33	7	7	37	32
118	118	221	214	24	19	271	228
91	58	34	34	5	5	113	74
170	20	406	123	19	5	1,113	360
316	86	135	63	17	.....	459	63
262	64	42	.....	.....	.....	416	74
.....	.....	326	218	.....	.....	253	161
420	10,776	15,605	11,056	1,245	1,035	38,407	22,542
70		71		83		59	
1.2		1.3		0.1		2.9	

Total for Metal-Working Industry.....	897,

Foundry Eq

	Total Now Pla
Sand Conditioning Equipment	
Riddles, Power	4
Screens, Power, Rotary	
Power, Shaking	
Mixers (including cutters, millers)	3
Magnetic separators	
Molding Machines	
Roll over type, Plain	4
Jar	4
Squeezers, Plain	11
Jolt	7
Strippers, Plain	3
Jar	2
Other	2
Sand Slingers	
Pneumatic Sand Rammers	14
Core Making Machines	
Screens, Power	
Mixers	1
Extrusion Machines	
Molding Machines	3
Core Baking Ovens	
Gas or Oil	4
Electric	
Coal or Coke	5
Mold Drying Ovens	
Gas or Oil	1
Electric	
Coal or Coke	1
Cupolas	4
Cupola or Furnace Chargers	2
Ladles	22
Melting Furnaces	
Gas or Oil	5
Electric	1
Power Shakeout Equipment	
Portable	
Stationary	
Sprue-Cutting Machinery	
Saw Type	
Shear Type	1
Pneumatic Chipping Hammers	14
Grinding Equipment	
Floor	8
Portable, Pneumatic	3
Portable, Electric	1
Swinging Frame Snaggers	1
Total for Metal-Working Industry	151

58	26	26	203	142			295	140
3	21	21	51	46			162	90
31	97	97	118	90	12	7	174	136
							19	17
23	20	20	31	31			103	52
73	100	65	218	154	19	15	270	191
5			5	5			201	9
39	247	101	195	167	4	4	360	258
61	1,339	1,242	1,938	1,482	171	147	3,334	2,110
6	30	23	130	117			108	40
36	77	70	94	94			276	236
40	120	120	88	61	30	30	116	116
58	209	181	124	108	20	20	454	297
224	481	448	571	358	17	15	510	298
16	267	239	56	56			250	48
160	299	45	147	147			178	105
89	188	141	109	102	22	22	447	286
55	91	57	276	190	12	7	591	351
33	46	46			5	5	285	157
20	27	22	23	14	2	2	42	29
17	6	6	28				205	203
	13	7	5				38	4
5	20	20					151	80
159	222	218	359	311	49	44	274	266
18	14	5	12	9			67	61
105	117	83	108	57	42	37	655	315
177	164	98	203	89			551	380
7	13	13	2				71	5
28							62	30
40	262	179	115	28	22	17	919	528
223	122	39	669	669	13	13	666	430
	28	28	104	56			140	53
402	1,970	1,265	361	175	12	12	1,233	674
97	161	140	206	152	10	5	780	367
71	176	42	125	61			327	271
276	366	217	538	374	28	28	709	483
	86	73	58	51			11	11
272	330	262	159	102	19	15	1,186	700
272	602	342	429	207	30	30	1,177	867
18	75	75	74	69	7	7	33	24
5	26	26	33	33	7	7	37	32
132	118	118	221	214	24	19	271	228
68	91	58	34	34	5	5	113	74
13	170	20	406	123	19	5	1,113	360
31	316	86	135	63	17		459	63
13	262	64	42				416	74
31			326	218			253	161
7,836	15,420	10,776	15,605	11,056	1,245	1,035	38,407	22,542
	70		71		83		59	
	1.2		1.3		0.1		2.9	

Total for Metal-Working In

Fou

Sand Conditioning Equipment
Riddles, Power
Screens, Power, Rotary
Power, Shaking
Mixers (including cutters, millers)
Magnetic separators
Molding Machines
Roll over type, Plain
Jar
Squeezers, Plain
Jolt
Strippers, Plain
Jar
Other
Sand Slingers
Pneumatic Sand Rammers
Core Making Machines
Screens, Power
Mixers
Extrusion Machines
Molding Machines
Core Baking Ovens
Gas or Oil
Electric
Coal or Coke
Mold Drying Ovens
Gas or Oil
Electric
Coal or Coke
Cupolas
Cupola or Furnace Chargers
Ladles
Melting Furnaces
Gas or Oil
Electric
Power Shakeout Equipment
Portable
Stationary
Sprue-Cutting Machinery
Saw Type
Shear Type
Pneumatic Chipping Hammers
Grinding Equipment
Floor
Portable, Pneumatic
Portable, Electric
Swinging Frame Snaggers
Total for Metal-Working Ind

rking Industry.....	897,775	466,166	52

Foundry Equipment

	Total Units Now in Place	More Than 10 Years Old	Per Cent Over 10 Years Old
uipment			
.....	4,290	2,337	54
y.....	954	645	68
.....	664	334	50
ers, millers).....	3,686	2,067	56
.....	719	393	55
.....	4,989	3,162	63
.....	4,655	3,172	68
.....	11,716	7,000	60
.....	7,942	4,368	55
.....	3,802	2,981	78
.....	2,030	1,587	78
.....	2,291	1,646	72
.....	924	219	24
mers.....	14,057	6,534	46
.....	495	297	60
.....	1,241	970	78
.....	908	655	72
.....	3,072	1,201	39
.....	4,773	2,682	56
.....	360	278	77
.....	5,599	4,481	80
.....	1,643	833	51
.....	95	.....	100
.....	1,129	886	78
.....	4,649	3,620	78
rgers.....	2,293	1,548	68
.....	22,197	14,772	67
.....	5,225	3,540	68
.....	1,221	547	45
ment			
.....	355	44	12
.....	699	129	18
ery			
.....	734	426	58
.....	1,531	1,103	72
ammers.....	14,969	4,553	30
.....	8,557	5,554	65
.....	3,329	1,216	37
.....	1,608	718	45
rs.....	1,959	1,144	58
rking Industry.....	151,360	87,642	58

AMER

Production Equipment	Agricultural Implements		Aircraft, Aircraft Engines and Parts		Motor Vehicles		Motor Vehicle Bodies and Parts		Con ing
	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total No Pl
Bending Machines									
Brakes	112	49	36	6	515	240	464	169	
Rolls	169	98	12	.....	409	284	1,267	485	
Straightening	27	22	31	12	249	169	612	295	
Other	298	253	31	.....	231	222	634	317	
Boring Machines									
Horizontal	153	51	56	12	604	160	739	295	
Vertical	155	98	12	6	924	480	1,372	1,119	
Jig	12	.....	24	.....	18	.....	63	21	
Other	.....	.....	.....	.....	.....	.....	.....	.....	
Broaching Machines	76	31	18	.....	1,333	755	887	380	
Cutting-off Machines									
Band-saw	98	63	93	6	1,075	569	739	464	
Rotary cold saw	29	22	6	.....	604	418	1,162	697	
Hack-saw	286	147	94	12	284	222	1,583	845	
Abrasive disk	12	10	18	6	124	80	295	168	
Other	47	29	30	.....	293	204	739	506	
Drilling Machines									
Horizontal:									
Single-spindle	45	24	62	6	80	9	781	253	
Multiple-spindle	45	6	37	.....	435	204	2,576	823	
Vertical:									
Multiple-spindle	296	155	187	25	5,331	3,261	4,158	1,858	
Standard (upright)	2,121	1,518	683	43	14,971	8,867	16,109	7,643	
Sensitive:									
Single-spindle	292	180	249	61	373	151	3,674	2,068	
Multiple-spindle	190	59	891	62	160	9	2,069	696	
Radial	263	63	124	6	1,670	897	803	317	
2, 3, 4 or 5 way	290	76	12	.....	160	9	63	.....	
Centering machines	45	28	30	6	489	391	549	422	
Other	121	61	6	.....	1,333	.....	1,667	1,161	
Honing Machines	24	2	31	.....	142	27	169	84	
Forging Machines									
Hammers									
Drop	339	309	.....	.....	36	36	211	169	
Steam or air operated	26	20	.....	.....	249	195	84	21	
Other power	145	131	12	.....	320	284	443	379	
Forging presses, hydraulic	4	4	12	.....	329	204	317	317	
Hot forging machines	6	4	.....	.....	107	89	1,668	359	
Cold forging machines	.....	.....	.....	.....	.....	.....	105	84	.....
Swaging machines	2	2	31	.....	36	27	485	84	
Other	4	4	37	.....	.....	.....	295	21	
Gear-Cutting Machines									
Formed rotary-cutter type:									
Spur and helical	51	43	25	25	1,466	853	738	591	
Bevel	39	12	19	.....	213	124	42	42	
Generators									
Shapers (Fellows-type)	115	29	149	41	2,266	1,466	570	296	
Bevel, spiral bevel and hypoid	57	16	12	12	1,004	737	42	42	
Herringbone	.....	.....	.....	.....	.....	.....	.....	.....	
Hobbing	291	168	81	44	1,759	995	3,124	1,668	
Shaving and finishing	20	4	12	.....	569	435	84	84	.....
Other	25	4	6	.....	.....	.....	42	42	
Grinding Machines									
Cutter and tool	286	159	378	37	2,488	1,706	4,644	2,893	
Drill	68	49	12	6	409	293	655	338	
Floor	964	736	180	31	4,060	2,532	5,109	1,485	
Bench	106	74	230	12	569	382	1,626	569	
Disk	82	49	43	.....	764	533	1,667	1,013	
External cylindrical, plain and universal	223	212	266	55	5,624	3,927	6,588	4,412	
Internal cylindrical	72	31	417	44	1,768	1,279	1,900	569	
Surface, horizontal and vertical	115	63	192	30	1,306	737	3,484	1,563	
Centerless	31	4	31	.....	586	178	1,584	105	
Other	268	237	.....	.....	.....	.....	759	169	
Keyseaters	81	57	.....	.....	169	160	633	528	
Lapping Machines	12	.....	37	.....	666	80	.....	.....	

IERICAN MACHINIST 1935 Inventory o

By Twenty Industrial Divisio

icle Parts		Construction Mining and Oil-Well Equipment		Conveying and Transmission Equipment		Domestic Electrical Appliances		Industrial Electrical Equipment		Engines, Turbines and Water Wheels		Fabricated Metal Products		Food Machinery		
re Than Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Now Pl
169	112	57	100	57	96	51	564	251	75	35	5,769	3,457	268	192	
485	199	145	133	88	129	40	537	319	178	128	7,969	5,964	338	269	
295	51	23	67	51	2	2	210	130	42	38	1,728	975	18	18	
317	136	79	85	61	45	25	440	168	.....	.....	4,154	2,843	69	69	
295	528	269	141	104	29	16	666	515	946	841	4,012	3,260	183	105	
1,119	619	471	216	143	33	27	1,980	1,533	845	712	9,338	7,720	217	192	
21	10	.....	11	8	12	.....	180	21	31	18	84	.....	17	9	
.....	10	5	10	5	29	.....	67	.....	44	40	334	84	27	18	
380	93	56	106	67	24	12	276	171	66	62	1,311	1,115	26	17	
464	105	94	135	107	63	18	1,156	766	132	116	4,403	2,453	131	115	
697	133	87	45	33	10	4	486	332	110	83	2,341	1,588	78	61	
845	429	291	231	170	129	94	788	516	278	172	8,371	6,408	512	338	
168	60	56	18	14	16	4	193	54	30	12	1,700	1,422	26	17	
506	65	14	96	51	59	24	608	272	70	48	1,560	920	60	52	
253	195	148	95	72	97	72	139	21	151	139	3,928	3,176	426	314	
823	37	32	98	53	39	14	196	125	26	4	1,421	837	61	44	
1,858	153	134	224	144	277	162	1,266	745	159	131	5,574	4,208	217	157	
7,643	885	747	587	414	630	408	3,162	2,574	1,168	1,009	19,145	14,408	964	773	
2,068	304	244	163	123	445	186	2,744	2,141	606	487	6,717	1,556	434	348	
696	153	106	67	43	414	195	4,359	2,412	226	177	1,923	1,589	70	52	
317	718	510	197	143	61	41	2,111	1,528	1,154	823	8,944	6,828	426	278	
.....	46	46	61	45	10	4	50	42	106	66	641	446	43	43	
422	75	47	48	38	37	25	93	42	71	62	864	697	44	35	
1,161	24	19	174	85	189	111	1,170	563	74	39	837	447	166	95	
84	10	5	6	3	16	2	130	63	31	.....	223	167	18	9	
169	125	111	27	22	6	4	335	306	70	66	2,119	1,812	35	35	
21	172	168	34	31	4	4	248	214	71	66	2,731	2,452	9	9	
379	172	166	27	21	8	4	79	58	45	45	1,199	725	44	27	
317	72	65	135	69	.....	.....	1,135	725	.....	.....	2,176	1,952	35	18	
359	79	42	25	22	.....	.....	87	47	.....	.....	697	669	.....	.....	
84	.....	.....	13	11	21	18	155	54	.....	.....	56	56	.....	.....	
84	28	28	14	3	35	8	227	142	61	61	920	446	17	17	
21	23	23	8	3	.....	.....	8	4	9	9	196	168	43	43	
591	88	69	417	308	64	55	227	205	203	198	2,536	1,867	88	88	
42	19	14	16	11	16	12	25	25	22	22	1,394	837	44	35	
296	52	43	85	63	16	10	75	42	70	39	2,145	1,393	69	35	
42	19	14	104	88	2	2	79	33	4	4	1,088	1,060	9	.....	
.....	5	.....	29	.....	.....	.....	.....	.....	.....	.....	641	195	9	.....	
1,668	134	56	153	65	18	8	368	239	177	137	3,817	2,340	166	96	
84	.....	.....	.....	.....	.....	.....	8	.....	.....	.....	474	251	.....	.....	
42	5	.....	.....	.....	.....	.....	8	4	9	9	613	119	.....	.....	
2,893	670	522	347	276	231	144	1,971	1,194	862	760	12,373	8,097	287	191	
338	176	89	94	78	53	39	568	205	168	105	2,452	1,504	148	122	
1,485	772	513	323	253	427	299	2,319	1,721	866	751	12,931	9,001	739	556	
569	251	190	87	62	44	40	897	549	317	207	5,630	3,986	270	199	
1,013	116	60	94	77	81	47	851	587	182	146	2,035	1,366	122	70	
4,412	213	151	138	78	372	331	1,358	875	362	274	9,001	4,541	79	53	
569	199	126	82	32	88	31	416	159	115	88	3,094	1,440	61	44	
1,563	121	65	222	156	295	153	2,078	959	145	101	6,242	4,237	157	105	
105	10	.....	53	16	35	4	280	117	8	8	530	56	9	.....	
169	34	19	84	45	166	110	1,984	1,412	176	57	3,289	1,560	52	9	
528	189	129	162	128	14	4	298	221	191	160	1,712	1,255	191	147	
.....	65	56	3	3	20	2	164	25	22	9	529	196	.....	.....	

AMERICAN MACHINIST 1935 In

By Twenty In

Motor Vehicles		Motor Vehicle Bodies and Parts		Construction Mining and Oil-Well Equipment		Conveying and Transmission Equipment		Domestic Electrical Appliances		Industrial Electrical Equipment		Engines, Turbines and Water Wheels		Fabrica Meta Produc
tal Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place
515	240	464	169	112	57	100	57	96	51	564	251	75	35	5,769
409	284	1,267	485	199	145	133	88	129	40	537	319	178	128	7,969
249	169	612	295	51	23	67	51	2	2	210	130	42	38	1,728
231	222	634	317	136	79	85	61	45	25	440	168	.....	.....	4,154
604	160	739	295	528	269	141	104	29	16	666	515	946	841	4,012
924	480	1,372	1,119	619	471	216	143	33	27	1,980	1,533	845	712	9,338
18	.....	63	21	10	.....	11	8	12	.....	180	21	31	18	84
.....	.....	.....	.....	10	5	10	5	29	.....	67	.....	44	40	334
1,333	755	887	380	93	56	106	67	24	12	276	171	66	62	1,311
1,075	569	739	464	105	94	135	107	63	18	1,156	766	132	116	4,403
604	418	1,162	697	133	87	45	33	10	4	486	332	110	83	2,341
284	222	1,583	845	429	291	231	170	129	94	788	516	278	172	8,371
124	80	295	168	60	56	18	14	16	4	193	54	30	12	1,700
293	204	739	506	65	14	96	51	59	24	608	272	70	48	1,560
80	9	781	253	195	148	95	72	97	72	139	21	151	139	3,928
435	204	2,576	823	37	32	98	53	39	14	196	125	26	4	1,421
5,331	3,261	4,158	1,858	153	134	224	144	277	162	1,266	745	159	131	5,574
14,971	8,867	16,109	7,643	885	747	587	414	630	408	3,162	2,574	1,168	1,009	19,145
373	151	3,674	2,068	304	244	163	123	445	186	2,744	2,141	606	487	6,717
160	9	2,069	696	153	106	67	43	414	195	4,359	2,412	226	177	1,923
1,670	897	803	317	718	510	197	143	61	41	2,111	1,528	1,154	823	8,944
160	9	63	.....	46	46	61	45	10	4	50	42	106	66	641
489	391	549	422	75	47	48	38	37	25	93	42	71	62	864
1,333	.....	1,667	1,161	24	19	174	85	189	111	1,170	563	74	39	837
142	27	169	84	10	5	6	3	16	2	130	63	31	.....	223
36	36	211	169	125	111	27	22	6	4	335	306	70	66	2,119
249	195	84	21	172	168	34	31	4	4	248	214	71	66	2,731
320	284	443	379	172	166	27	21	8	4	79	58	45	45	1,199
329	204	317	317	72	65	135	69	.....	.....	1,135	725	.....	.....	2,176
107	89	1,668	359	79	42	25	22	.....	.....	87	47	.....	.....	697
.....	.....	105	84	.....	.....	13	11	21	18	155	54	.....	.....	56
36	27	485	84	28	28	14	3	35	8	227	142	61	61	920
.....	.....	295	21	23	23	8	3	.....	.....	8	4	9	9	196
1,466	853	738	591	88	69	417	308	64	55	227	205	203	198	2,536
213	124	42	42	19	14	16	11	16	12	25	25	22	22	1,394
2,266	1,466	570	296	52	43	85	63	16	10	75	42	70	39	2,145
1,004	737	42	42	19	14	104	88	2	2	79	33	4	4	1,088
.....	.....	.....	.....	5	.....	29	.....	.....	.....	.....	.....	.....	.....	641
1,759	995	3,124	1,668	134	56	153	65	18	8	368	239	177	137	3,817
569	435	84	84	.....	.....	.....	.....	.....	.....	8	.....	.....	.....	474
.....	.....	42	42	5	.....	.....	.....	.....	.....	8	4	9	9	613
2,488	1,706	4,644	2,893	670	522	347	276	231	144	1,971	1,194	862	760	12,373
409	293	655	338	176	89	94	78	53	39	568	205	168	105	2,452
4,060	2,532	5,109	1,485	772	513	323	253	427	299	2,319	1,721	866	751	12,931
569	382	1,626	569	251	190	87	62	44	40	897	549	317	207	5,630
764	533	1,667	1,013	116	60	94	77	81	47	851	587	182	146	2,035
5,624	3,927	6,588	4,412	213	151	138	78	372	331	1,358	875	362	274	9,001
1,768	1,279	1,900	569	199	126	82	32	88	31	416	159	115	88	3,094
1,306	737	3,484	1,563	121	65	222	156	295	153	2,078	959	145	101	6,242
586	178	1,584	105	10	.....	53	16	35	4	280	117	8	8	530
.....	.....	759	169	34	19	84	45	166	110	1,984	1,412	176	57	3,289

Inventory of Metal-Working Equipment

ty Industrial Divisions

Fabricated Metal Products		Food Machinery		Foundry Products		Machinery Not Otherwise Classified		Metal-Working Machinery and Accessories		Office Equipment		Printing, Pulp and Paper Machinery		Pumps, F and Compress	
Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	Mo 10
5,769	3,457	268	192	30	25	1,334	651	31	19	64	78	6	4	54	
7,969	5,964	338	269	103	93	1,149	869	45	33	29	25	13	11	60	
1,728	975	18	18	29	29	279	248	90	73	.....	.....	15	15	24	
4,154	2,843	69	69	30	15	434	279	14	6	3	3	4	2	20	
4,012	3,260	183	105	296	215	2,329	1,396	1,140	628	3	3	76	64	336	
9,338	7,720	217	192	573	475	2,422	2,298	477	363	29	6	75	57	401	
84	.....	17	9	19	15	279	186	100	14	22	.....	6	2	7	
334	84	27	18	20	15	.....	.....	82	61	83	83	.....	.....	.....	
1,311	1,115	26	17	30	20	317	317	208	117	29	16	28	16	64	
4,403	2,453	131	115	376	251	1,397	1,180	292	215	80	32	51	27	60	
2,341	1,588	78	61	166	147	651	496	404	250	32	29	85	60	73	
8,371	6,408	512	338	506	422	2,514	1,366	578	384	121	96	151	106	275	
1,700	1,422	26	17	117	60	434	310	41	24	3	3	31	29	33	
1,560	920	60	52	20	15	434	372	191	158	48	45	7	7	10	
3,928	3,176	426	314	194	171	1,304	1,055	305	191	672	401	100	92	70	
1,421	837	61	44	133	103	217	186	123	66	32	16	110	108	17	
5,574	4,208	217	157	190	162	1,148	713	485	338	873	503	333	138	281	
19,145	14,408	964	773	1,191	932	7,539	6,391	1,947	1,511	395	357	454	328	1,067	
6,717	1,556	434	348	190	142	2,576	1,862	947	640	790	573	163	145	303	
1,923	1,589	70	52	45	30	931	651	807	589	1,338	1,039	145	76	80	
8,944	6,828	426	278	443	323	3,632	2,515	1,584	821	38	19	198	130	559	
641	446	43	43	5	5	.....	.....	63	40	.....	.....	8	4	37	
864	697	44	35	69	59	434	372	255	213	13	13	18	16	62	
837	447	166	95	43	34	558	403	150	120	675	366	31	11	84	
223	167	18	9	5	.....	93	.....	46	11	319	169	2	...	39	
2,119	1,812	35	35	151	122	621	496	109	96	19	19	11	8	25	
2,731	2,452	9	9	127	103	434	403	91	57	6	3	.....	.....	115	
1,199	725	44	27	107	87	372	344	59	45	3	3	11	11	29	
2,176	1,952	35	18	58	43	124	124	16	13	41	19	2	.....	94	
697	669	.....	.....	83	83	372	372	36	36	6	6	.....	.....	37	
56	56	.....	.....	10	10	.....	.....	.....	.....	.....	.....	.....	.....	3	
920	446	17	17	5	5	155	155	11	11	16	13	2	2	6	
196	168	43	43	49	34	.....	.....	17	17	.....	.....	.....	.....	3	
2,536	1,867	88	88	103	98	403	341	692	578	137	134	67	67	50	
1,394	837	44	35	15	10	31	31	175	131	41	35	17	15	.....	
2,145	1,393	69	35	35	35	248	248	445	194	16	13	13	8	53	
1,088	1,060	9	.....	5	5	248	217	202	120	10	.....	16	.....	3	
641	195	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	
3,817	2,340	166	96	44	39	775	527	455	218	185	115	19	17	80	
474	251	.....	.....	.....	.....	.....	.....	134	79	.....	.....	13	7	3	
613	119	.....	.....	5	5	62	62	65	44	3	.....	.....	.....	.....	
12,373	8,097	287	191	558	411	2,974	2,639	2,842	1,565	1,023	742	400	224	654	
2,452	1,504	148	122	133	88	682	527	461	223	.....	.....	53	35	101	
12,931	9,001	739	556	586	434	4,437	2,856	1,053	701	22	19	180	130	303	
5,630	3,986	270	199	327	233	1,489	776	540	268	80	54	93	44	182	
2,035	1,366	122	70	107	70	868	620	447	338	309	229	101	62	114	
9,001	4,541	79	53	181	132	1,244	775	2,471	1,668	159	124	99	55	511	
3,094	1,440	61	44	62	34	310	186	716	483	70	25	17	13	296	
6,242	4,237	157	105	88	54	1,210	558	1,708	963	312	166	475	305	310	
530	56	9	.....	29	20	31	.....	123	43	45	19	17	4	27	
3,289	1,560	52	9	132	74	300	279	594	284	131	67	10	6	27	
												44	28	97	

Equipment

ice ment		Printing, Pulp and Paper Machinery		Pumps, Fans and Compressors		Railroad Equipment and Repairs		Special Tools, Dies and Machines		Textile Machinery and Parts		Machine Totals		Per Cent Over Ten Years Old
	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	
	78	6	4	54	23	712	522	32	26	84	74	10,453	5,986	57
	25	13	11	60	40	1,341	1,031	43	37	180	172	14,303	10,131	71
	.....	15	15	24	6	364	289	75	38	239	196	4,152	2,629	63
	3	4	2	20	20	879	642	19	.....	11	8	7,537	5,012	66
	3	76	64	336	255	1,573	1,233	401	263	56	26	14,267	9,711	68
	6	75	57	401	344	3,072	2,177	383	314	98	88	23,241	18,623	80
	.....	6	2	7	.....	.....	.....	75	69	32	11	1,002	374	37
	83	.....	.....	.....	.....	330	207	44	25	24	.....	1,104	543	49
	16	28	16	64	36	173	87	90	81	103	96	5,258	3,452	66
	32	51	27	60	47	487	376	170	94	82	51	11,120	7,044	63
	29	85	60	73	44	448	337	364	270	95	50	7,322	5,008	68
	96	151	106	275	173	1,232	896	806	567	170	91	19,338	13,316	69
	3	31	29	33	19	152	73	64	25	24	8	3,391	2,394	71
	45	7	7	10	7	331	278	95	19	8	3	4,771	3,024	63
	401	100	92	70	67	245	192	364	233	109	77	9,362	6,713	72
	16	110	108	17	14	217	152	107	82	56	34	5,983	2,903	49
	503	333	138	281	222	1,227	923	642	515	678	500	23,699	14,994	63
	357	454	328	1,067	953	3,973	3,288	1,779	1,365	1,366	1,123	80,136	54,652	68
	573	163	145	303	207	1,299	890	1,352	817	278	206	23,899	13,027	55
	1,039	145	76	80	73	313	303	290	233	172	114	14,643	8,508	58
	19	198	130	559	379	4,465	3,212	622	377	114	80	28,126	19,290	69
	.....	8	4	37	31	297	160	101	82	22	22	2,015	1,121	56
	13	18	16	62	47	449	344	202	164	53	43	3,900	3,064	79
	366	31	11	84	37	402	140	31	19	175	109	7,912	3,820	48
	169	2	...	39	6	21	14	6	.....	.....	.....	1,331	562	42
	19	11	8	25	22	442	238	75	62	48	42	4,804	3,975	83
	3	.....	.....	115	111	2,194	1,772	56	38	11	11	6,662	5,678	85
	3	11	11	29	23	771	632	132	120	87	87	4,065	3,192	79
	19	2	.....	94	80	634	291	100	.....	32	29	5,316	3,953	74
	6	.....	.....	37	27	1,411	1,186	.....	.....	32	24	4,646	2,966	64
	.....	.....	.....	3	.....	60	53	.....	.....	26	26	449	312	69
	13	2	2	6	6	270	198	6	.....	114	32	2,441	1,240	51
	.....	.....	.....	3	.....	443	317	19	19	3	.....	1,157	662	57
	134	67	67	50	33	118	92	128	119	85	79	7,686	5,843	76
	35	17	15	.....	.....	40	27	151	125	50	37	2,369	1,545	65
	13	13	8	53	40	158	158	182	163	119	67	6,881	4,383	64
	.....	16	.....	3	.....	20	20	12	6	22	14	2,958	2,390	81
	.....	.....	.....	3	.....	.....	.....	.....	.....	3	3	690	198	29
	115	19	17	80	67	60	47	75	68	56	42	11,837	5,956	50
	.....	13	7	3	3	.....	.....	.....	.....	.....	.....	1,317	863	66
	.....	.....	.....	.....	.....	73	73	6	6	13	11	935	379	41
	742	400	224	654	507	2,827	1,951	904	408	448	337	37,167	24,763	67
	.....	53	35	101	46	652	365	363	163	116	90	7,364	4,365	59
	19	180	130	503	242	6,914	4,318	1,151	762	728	531	44,064	27,871	63
	54	93	44	182	124	699	382	328	201	318	240	14,083	8,592	61
	229	101	62	114	70	471	240	334	170	71	45	8,759	5,792	66
	124	99	55	511	407	766	402	1,126	849	395	347	31,176	19,668	63
	25	17	13	296	192	463	147	515	313	56	27	10,717	5,263	49
	166	475	305	310	269	653	355	1,063	477	225	114	20,401	11,430	56
	19	17	4	27	13	143	92	19	6	43	11	3,634	696	19
	67	10	6	27	27	508	402	207	155	19	6	8,740	4,918	56

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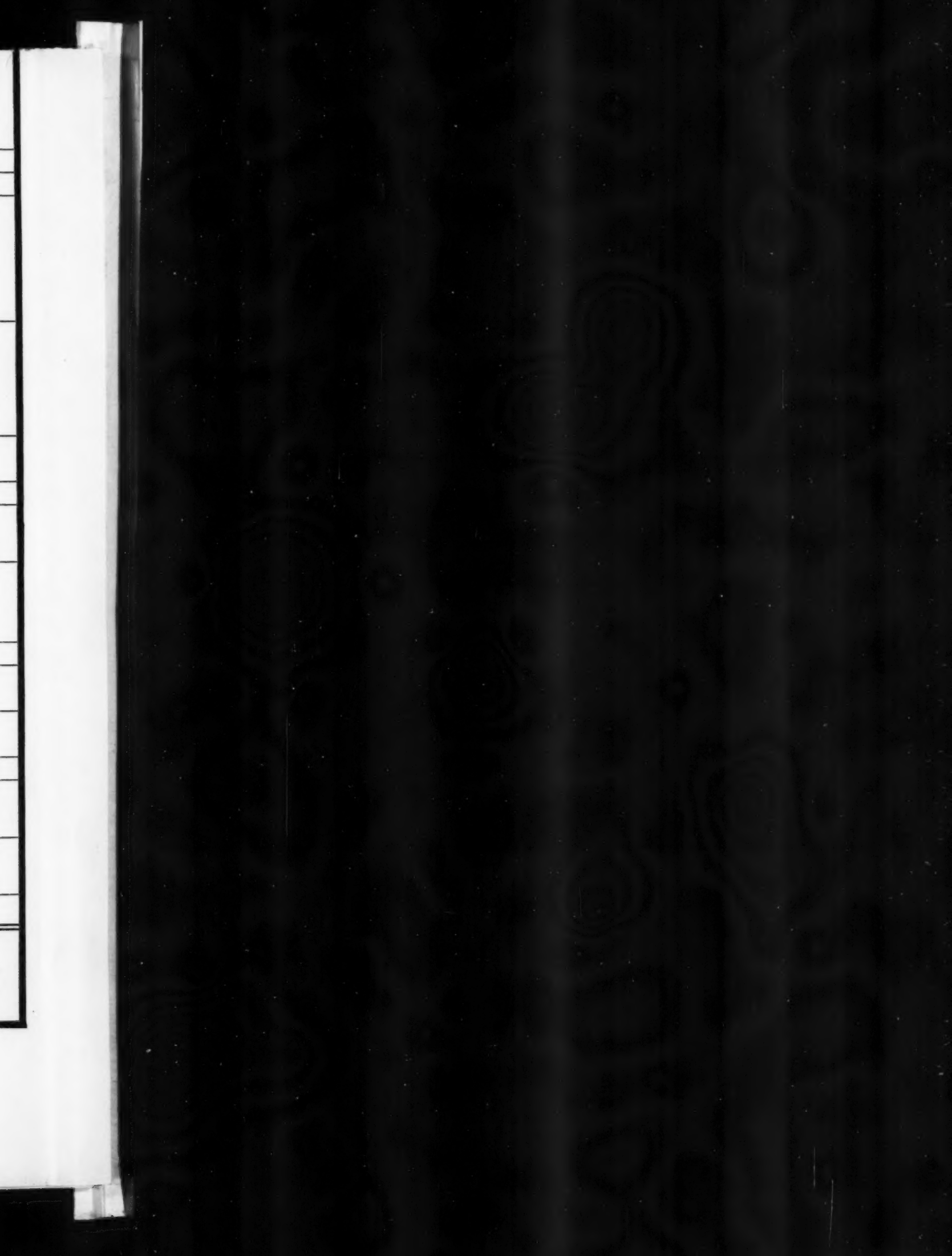
Floor	964	736	180	31	4,060	2,532	5,109	1,485	772	513	323	
Bench	106	74	230	12	569	382	1,626	569	251	190	87	
Disk	82	49	43	.....	764	533	1,667	1,013	116	60	94	
External cylindrical, plain and universal	223	212	266	55	5,624	3,927	6,588	4,412	213	151	138	
Internal cylindrical	72	31	417	44	1,768	1,279	1,900	569	199	126	82	
Surface, horizontal and vertical	115	63	192	30	1,306	737	3,484	1,563	121	65	222	
Centerless	31	4	31	.....	586	178	1,584	105	10	.....	53	
Other	268	237	.....	.....	.....	.....	759	169	34	19	84	
Keyseaters	81	57	.....	.....	169	160	633	528	189	129	162	
Lapping Machines	12	.....	37	.....	666	80	.....	.....	65	56	3	
Lathes												
Bench	76	62	74	12	293	71	2,027	1,668	33	33	48	
Engine (including toolroom)	895	560	915	211	8,521	5,464	15,328	9,078	1,935	1,608	1,192	
Automatic multiple-spindle	233	84	224	6	5,953	3,430	9,037	4,011	106	102	152	
Automatic single-spindle	289	88	255	25	2,239	1,590	4,771	1,393	254	198	247	
Wheel and axle (R.R.)	10	4	12	12	.....	.....	781	781	33	33	.....	.....
Turret												
Ram type	29	61	411	31	3,483	2,408	7,482	5,194	204	102	333	
Saddle type	478	194	441	43	942	578	2,576	1,625	977	737	313	
Other	55	16	12	.....	551	498	2,069	1,331	124	87	58	
Milling Machines												
Hand (no power feed)	74	39	143	50	1,733	968	3,547	2,555	75	62	111	
Plain	333	209	522	37	5,367	3,039	6,715	3,209	409	327	287	
Universal	63	35	155	37	506	320	1,837	1,394	212	143	152	
Vertical	65	41	211	12	924	498	528	254	106	91	32	
Planer type	88	69	.....	.....	133	44	63	21	130	70	43	
Lincoln type	33	33	6	6	418	418	274	169	51	32	61	
Continuous (including rotary)	55	.....	.....	.....	320	116	295	168	15	5	26	
Other	82	18	24	.....	.....	.....	549	42	32	32	11	
Planers												
Standard	114	90	12	.....	178	124	423	317	409	336	99	
Open-side	8	2	.....	.....	9	9	63	63	59	51	35	
Pipe Cutting and Threading Machines	84	73	.....	.....	98	62	464	290	120	84	56	
Polishing and Buffing Machines												
Abrasive wheel	247	233	112	.....	2,008	613	2,703	1,731	93	89	76	
Abrasive belt	18	16	12	.....	36	27	232	.....	9	5	8	
Automatic	.....	.....	.....	.....	.....	.....	464	317	.....	.....	8	
Presses (not forging presses)												
Arbor	446	188	187	6	3,747	2,304	5,215	1,922	319	255	300	
Crank type	196	131	6	.....	6,359	363	1,857	613	65	46	369	
Toggle type	27	18	6	.....	860	232	549	253	24	.....	56	
Punch	709	470	292	12	4,350	2,418	20,438	9,670	549	407	1,307	
Other	260	78	43	.....	524	382	2,555	865	76	52	190	
Riveting Machines (not portable)	212	131	93	12	3,998	1,102	2,660	718	207	147	312	
Shapers												
Horizontal	216	155	69	18	666	418	1,816	1,098	355	271	259	
Vertical	16	14	30	.....	107	53	316	211	42	33	17	
Shears												
Hand	107	96	62	12	71	62	654	380	98	93	59	
Power	271	200	24	6	942	480	1,963	1,500	364	266	200	
Slotters	27	22	24	.....	178	124	105	63	37	28	34	
Threading Machines (except for pipe)												
Hobbing and milling	29	2	74	.....	338	107	2,385	2,132	23	5	26	
Die type	145	98	6	6	835	551	802	338	142	125	40	
Tapping	113	49	68	12	755	151	2,195	908	108	98	29	
Welding and Cutting Machines												
Electric arc	127	12	12	.....	4,238	471	2,808	3,615	374	83	263	
Gas	10	4	18	.....	9	9	232	21	65	25	54	
Resistance	33	20	6	.....	382	231	675	275	33	29	19	
Other Machine Tools	.....	.....	87	.....	.....	.....	2,886	380	9	9	645	2
Totals by Industrial Divisions	14,911	9,081	9,603	1,172	120,641	64,615	192,412	99,502	17,235	12,606	13,417	9,3
Per Cent Over 10 Years Old	**61**		**12**		**54**		**52**		**73**		**70**	
Per Cent of Total Equipment in Each Industrial Division	**1.1**		**0.7**		**9.0**		**14.3**		**1.3**		**1.0**	

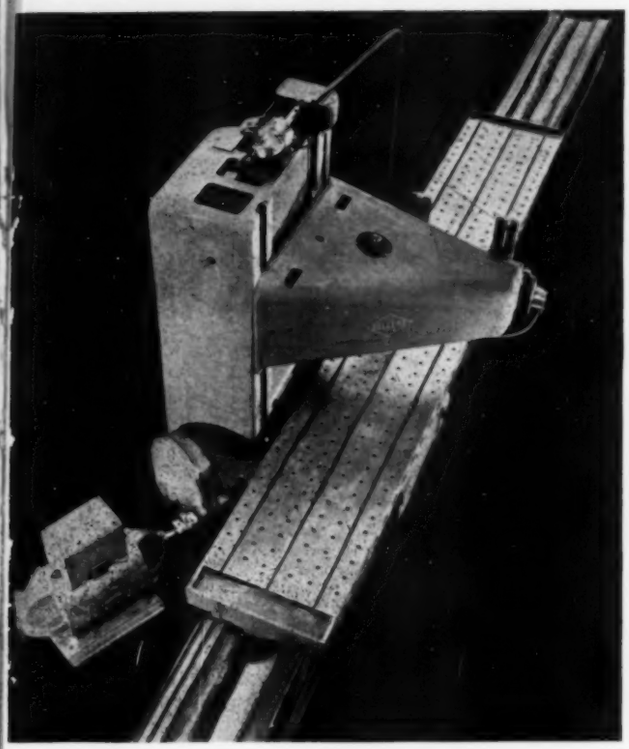
323	253	427	299	2,319	1,721	866	751	12,931	[illegible]	739	556	586	434	4,437	2,8
87	62	44	40	897	549	317	207	5,630	3,986	270	199	327	233	1,489	7
94	77	81	47	851	587	182	146	2,035	1,366	122	70	107	70	868	6
138	78	372	331	1,358	875	362	274	9,001	4,541	79	53	181	132	1,244	7
82	32	88	31	416	159	115	88	3,094	1,440	61	44	62	34	310	1
222	156	295	153	2,078	959	145	101	6,242	4,237	157	105	88	54	1,210	5
53	16	35	4	280	117	8	8	530	56	9	.....	29	20	31	.....
84	45	166	110	1,984	1,412	176	57	3,289	1,560	52	9	132	74	300	2
162	128	14	4	298	221	191	160	1,712	1,255	191	147	209	172	1,055	9
3	3	20	2	164	25	22	9	529	196	.....	.....	44	44	93	
48	38	439	285	2,710	1,805	127	110	4,458	3,066	122	104	161	126	1,719	1,4
1,192	998	773	505	9,137	6,746	2,715	2,215	38,010	31,294	1,885	1,512	2,400	2,017	14,802	12,6
152	69	298	283	2,233	1,085	49	22	4,583	2,955	60	52	10	10	341	
247	194	335	287	1,282	554	397	348	5,628	2,459	200	139	40	40	869	4
.....	.....	154	82	37	29	49	49	374	374	9	9	138	137	31	
333	171	183	163	2,559	1,801	499	331	4,570	3,260	296	192	219	185	2,140	1,6
313	233	322	201	2,881	1,759	645	522	8,945	6,353	287	139	230	210	4,067	2,8
58	55	320	156	887	686	79	62	8,081	5,267	199	138	313	284	806	6
111	92	205	131	938	712	151	120	3,343	2,787	43	43	49	35	403	2
287	219	250	172	2,877	1,863	800	673	6,744	5,434	486	388	280	255	2,795	1,9
152	120	166	94	1,109	632	544	388	5,434	4,180	296	165	249	215	1,987	1,4
32	21	164	92	1,738	1,110	155	114	1,867	1,310	139	96	113	68	547	3
43	30	26	18	205	143	124	85	1,171	921	26	26	24	24	434	3
61	51	16	.....	158	112	181	181	363	307	18	18	5	5	124	
26	19	24	10	100	59	9	9	279	167	9	9	5	5	.....	.....
11	11	50	32	382	256	145	102	754	559	43	43	83	64	124	
99	92	30	24	662	599	481	420	6,269	5,852	312	303	661	617	3,695	3,5
35	35	.....	.....	159	96	67	62	670	503	52	35	68	54	488	
56	48	33	14	934	465	204	141	2,591	2,118	164	122	166	136	1,005	
76	48	595	319	1,051	707	92	57	9,249	5,462	243	166	176	126	1,242	
8	3	20	8	528	277	4	.....	2,230	864	44	35	5	5	248	
8	3	111	57	252	122	.....	.....	2,704	1,450	.....	.....	.....	.....	.....	.....
300	228	748	478	2,584	1,956	359	296	7,969	3,567	479	390	196	118	2,328	1,
369	309	653	351	1,331	829	71	71	18,614	15,690	70	35	44	30	745	
56	42	54	22	4,695	2,735	35	27	1,644	1,199	17	17	161	122	124	
1,307	981	2,311	1,507	5,919	4,704	292	261	40,157	31,990	556	435	122	88	4,406	3,
190	168	819	283	4,033	2,329	106	97	6,381	3,094	86	70	118	94	589	
312	222	210	121	1,181	332	58	31	5,852	4,320	95	70	59	54	527	
259	195	171	149	2,336	1,541	553	428	9,865	7,554	382	348	546	468	2,671	2,
17	17	36	24	381	235	22	12	279	140	9	.....	68	49	155	
59	34	130	102	462	322	98	66	6,716	4,570	356	243	83	79	869	
200	111	172	119	1,623	1,303	169	110	10,534	7,468	261	190	210	191	1,831	1,
34	32	60	58	405	352	133	114	1,449	1,309	35	26	68	63	682	
26	19	20	10	75	41	106	92	2,424	1,143	9	9	20	15	217	
40	27	84	65	280	146	164	141	2,258	1,812	69	52	107	97	775	
29	19	227	109	1,156	671	26	26	4,014	3,039	53	44	92	92	372	
263	80	66	14	1,712	361	189	44	6,911	2,256	347	131	196	88	1,894	
54	19	8	2	411	84	93	22	3,005	977	68	17	148	44	1,210	
19	8	106	21	2,379	770	26	13	5,127	1,699	53	9	5	5	993	
645	246	80	29	552	239	.....	.....	2,436	1,740	296	269	5	5	2,423	1
,417	9,350	15,376	9,255	104,153	65,994	20,791	16,426	439,863	306,658	15,696	11,608	15,719	12,523	111,621	82,
70		**60**		**63**		**79**		**70**		**74**		**80**		**74**	
1.0		**1.1**		**7.8**		**1.5**		**32.7**		**1.2**		**1.2**		**8.3**	

4,060	2,532	5,109	1,485	772	513	323	253	427	299	2,319	1,721	866	751	12,931	
569	382	1,626	569	251	190	87	62	44	40	897	549	317	207	5,630	
764	533	1,667	1,013	116	60	94	77	81	47	851	587	182	146	2,035	
5,624	3,927	6,588	4,412	213	151	138	78	372	331	1,358	875	362	274	9,001	
1,768	1,279	1,900	569	199	126	82	32	88	31	416	159	115	88	3,094	
1,306	737	3,484	1,563	121	65	222	156	295	153	2,078	959	145	101	6,242	
586	178	1,584	105	10	.....	53	16	35	4	280	117	8	8	530	
.....	.....	759	169	34	19	84	45	166	110	1,984	1,412	176	57	3,289	
169	160	633	528	189	129	162	128	14	4	298	221	191	160	1,712	
666	80	.....	.....	65	56	3	3	20	2	164	25	22	9	529	
293	71	2,027	1,668	33	33	48	38	439	285	2,710	1,805	127	110	4,458	
8,521	5,464	15,328	9,078	1,935	1,608	1,192	998	773	505	9,137	6,746	2,715	2,215	38,010	3
5,953	3,430	9,037	4,011	106	102	152	69	298	283	2,233	1,085	49	22	4,583	
2,239	1,590	4,771	1,393	254	198	247	194	335	287	1,282	554	397	348	5,628	
.....	.....	781	781	33	33	.....	.....	154	82	37	29	49	49	374	
3,483	2,408	7,482	5,194	204	102	333	171	183	163	2,559	1,801	499	331	4,570	
942	578	2,576	1,625	977	737	313	233	322	201	2,881	1,759	645	522	8,945	
551	498	2,069	1,331	124	87	58	55	320	156	887	686	79	62	8,081	
1,733	968	3,547	2,555	75	62	111	92	205	131	938	712	151	120	3,343	
5,367	3,039	6,715	3,209	409	327	287	219	250	172	2,877	1,863	800	673	6,744	
506	320	1,837	1,394	212	143	152	120	166	94	1,109	632	544	388	5,434	
924	498	528	254	106	91	32	21	164	92	1,738	1,110	155	114	1,867	
133	44	63	21	130	70	43	30	26	18	205	143	124	85	1,171	
418	418	274	169	51	32	61	51	16	.....	158	112	181	181	363	
320	116	295	168	15	5	26	19	24	10	100	59	9	9	279	
.....	.....	549	42	32	32	11	11	50	32	382	256	145	102	754	
178	124	423	317	409	336	99	92	30	24	662	599	481	420	6,269	
9	9	63	63	59	51	35	35	.....	.....	159	96	67	62	670	
98	62	464	290	120	84	56	48	33	14	934	465	204	141	2,591	
2,008	613	2,703	1,731	93	89	76	48	595	319	1,051	707	92	57	9,249	
36	27	232	.....	9	5	8	3	20	8	528	277	4	.....	2,230	
.....	.....	464	317	.....	.....	8	3	111	57	252	122	.....	.....	2,704	
3,747	2,304	5,215	1,922	319	255	300	228	748	478	2,584	1,956	359	296	7,969	
6,359	363	1,857	613	65	46	369	309	653	351	1,331	829	71	71	18,614	1
860	232	549	253	24	.....	56	42	54	22	4,695	2,735	35	27	1,644	
4,350	2,418	20,438	9,670	549	407	1,307	981	2,311	1,507	5,919	4,704	292	261	40,157	3
524	382	2,555	865	76	52	190	168	819	283	4,033	2,329	106	97	6,381	
3,998	1,102	2,660	718	207	147	312	222	210	121	1,181	332	58	31	5,852	
666	418	1,816	1,098	355	271	259	195	171	149	2,336	1,541	553	428	9,865	
107	53	316	211	42	33	17	17	36	24	381	235	22	12	279	
71	62	654	380	98	93	59	34	130	102	462	322	98	66	6,716	
942	480	1,963	1,500	364	266	200	111	172	119	1,623	1,303	169	110	10,534	
178	124	105	63	37	28	34	32	60	58	405	352	133	114	1,449	
338	107	2,385	2,132	23	5	26	19	20	10	75	41	106	92	2,424	
835	551	802	338	142	125	40	27	84	65	280	146	164	141	2,258	
755	151	2,195	908	108	98	29	19	227	109	1,156	671	26	26	4,014	
4,238	471	2,808	3,615	374	83	263	80	66	14	1,712	361	189	44	6,911	
9	9	232	21	65	25	54	19	8	2	411	84	93	22	3,005	
382	231	675	275	33	29	19	8	106	21	2,379	770	26	13	5,127	
.....	.....	2,886	380	9	9	645	246	80	29	552	239	.....	.....	2,436	
20,641	64,615	192,412	99,502	17,235	12,606	13,417	9,350	15,376	9,255	104,153	65,994	20,791	16,426	439,863	306,
54		**52**		**73**		**70**		**60**		**63**		**79**		**70**	
9.0		**14.3**		**1.3**		**1.0**		**1.1**		**7.8**		**1.5**		**32.7**	

12,931	9,001	739	556	586	434	4,437	2,856	1,053	701	22	19	180	130	383
5,630	3,986	270	199	327	233	1,489	776	540	268	80	54	93	44	182
2,035	1,366	122	70	107	70	868	620	447	338	309	229	101	62	114
9,001	4,541	79	53	181	132	1,244	775	2,471	1,668	159	124	99	55	511
3,094	1,440	61	44	62	34	310	186	716	483	70	25	17	13	296
6,242	4,237	157	105	88	54	1,210	558	1,708	963	312	166	475	305	310
530	56	9	.....	29	20	31	.....	123	43	45	19	17	4	27
3,289	1,560	52	9	132	74	300	279	594	284	131	67	10	6	27
1,712	1,255	191	147	209	172	1,055	961	318	250	.....	.....	44	28	97
529	196	.....	.....	44	44	93	93	166	65	134	134	24	24	50
4,458	3,066	122	104	161	126	1,719	1,428	1,001	767	838	765	256	214	84
38,010	31,294	1,885	1,512	2,400	2,017	14,802	12,662	7,294	4,757	930	746	902	697	2,107
4,583	2,955	60	52	10	10	341	62	365	289	284	127	337	224	296
5,628	2,459	200	139	40	40	869	403	1,000	612	2,001	1,682	75	49	811
374	374	9	9	138	137	31	31	47	28	.....	.....	.....	.....	.....
4,570	3,260	296	192	219	185	2,140	1,645	1,684	1,137	80	22	84	55	500
8,945	6,353	287	139	230	210	4,067	2,826	1,815	981	421	360	157	108	561
8,081	5,267	199	138	313	284	806	682	854	745	147	96	60	31	497
3,343	2,787	43	43	49	35	403	279	567	429	765	640	202	133	74
6,744	5,434	486	388	280	255	2,795	1,955	3,016	1,977	1,370	1,035	1,497	1,031	647
5,434	4,180	296	165	249	215	1,987	1,491	1,375	914	258	207	383	299	292
1,867	1,310	139	96	113	68	547	372	899	479	191	96	181	115	181
1,171	921	26	26	24	24	434	310	218	123	363	249	18	18	87
363	307	18	18	5	5	124	124	1,045	823	284	284	18	16	37
279	167	9	9	5	5	.....	.....	32	11	19	16	2	2	.....
754	559	43	43	83	64	124	93	1,614	1,440	223	175	57	43	105
6,269	5,852	312	303	661	617	3,695	3,358	1,888	1,653	32	32	429	395	199
670	503	52	35	68	54	488	465	144	88	.....	.....	15	2	32
2,591	2,118	164	122	166	136	1,005	776	102	70	.....	.....	36	27	121
9,249	5,462	243	166	176	126	1,242	868	587	501	529	293	115	54	79
2,230	864	44	35	5	5	248	124	117	87	89	41	46	29	13
2,704	1,450	.....	.....	.....	.....	.....	.....	5	5	.....	.....	4	4	.....
7,969	3,567	479	390	196	118	2,328	1,770	1,650	1,361	133	99	251	206	407
18,614	15,690	70	35	44	30	745	652	64	32	.....	.....	4	4	80
1,644	1,199	17	17	161	122	124	124	96	16	57	25	13	6	3
40,157	31,990	556	435	122	88	4,406	3,507	319	259	1,870	1,309	395	354	124
6,381	3,094	86	70	118	94	589	496	350	275	140	96	22	11	83
5,852	4,320	95	70	59	54	527	217	95	41	828	424	55	39	33
9,865	7,554	382	348	546	468	2,671	2,327	930	683	112	92	136	103	232
279	140	9	.....	68	49	155	93	102	65	16	3	64	31	50
6,716	4,570	356	243	83	79	869	558	64	56	118	80	40	35	83
10,534	7,468	261	190	210	191	1,831	1,087	135	95	118	86	37	24	66
1,449	1,309	35	26	68	63	682	682	155	128	41	35	77	72	23
2,424	1,143	9	9	20	15	217	155	981	709	6	6	17	15	67
2,258	1,812	69	52	107	97	775	651	166	137	478	446	6	4	40
4,014	3,039	53	44	92	92	372	310	136	77	370	303	73	36	51
6,911	2,256	347	131	196	88	1,894	310	125	30	41	13	21	8	124
3,005	977	68	17	148	44	1,210	528	49	16	3	.....	24	9	62
5,127	1,699	53	9	5	5	993	93	38	16	134	96	2	.....	17
2,436	1,740	296	269	5	5	2,423	1,583	878	515	80	76	15	4	37
,863	306,658	15,696	11,608	15,719	12,523	111,621	82,803	56,353	37,802	21,828	15,869	9,920	7,020	15,497
70		74		80		74		67		73		71		77
32.7		1.2		1.2		8.3		4.2		1.6		0.7		1.2

19	180	130	303	242	6,914	4,318	1,151	762	728	531	44,064	27,871	63
54	93	44	182	124	699	382	328	201	318	240	14,083	8,592	61
229	101	62	114	70	471	240	334	170	71	45	8,759	5,792	66
124	99	55	311	407	766	402	1,126	849	395	347	31,176	19,668	63
25	17	13	296	192	463	147	515	313	56	27	10,717	5,263	49
166	475	305	310	269	653	355	1,063	477	225	114	20,401	11,430	56
19	17	4	27	13	143	92	19	6	43	11	3,634	696	19
67	10	6	27	27	508	402	207	155	19	6	8,740	4,918	56
.....	44	28	97	86	351	206	232	169	77	58	6,023	4,719	78
134	24	24	50	13	100	53	19	13	8	.....	2,156	810	38
765	256	214	84	60	2,834	1,932	925	654	140	63	18,363	13,263	72
746	902	697	2,107	1,830	9,689	7,634	4,528	2,289	2,638	2,099	126,596	94,922	75
127	337	224	296	235	100	60	25	19	328	212	25,014	13,337	53
1,682	75	49	811	701	437	291	206	131	802	704	22,138	11,888	54
.....	.....	.....	.....	.....	2,071	1,484	.....	.....	.....	.....	3,746	3,053	82
22	84	55	500	303	1,107	871	465	358	223	207	26,551	18,497	70
360	157	108	561	382	2,565	2,017	590	497	535	437	29,748	20,202	68
96	60	31	497	386	680	443	377	371	784	768	16,953	12,102	71
640	202	133	74	64	120	100	597	477	138	124	13,278	9,840	74
1,035	1,497	1,031	647	541	1,332	969	1,899	1,466	980	611	38,608	25,410	66
207	383	299	292	265	823	822	951	699	130	96	16,922	12,516	74
96	181	115	181	162	1,042	738	439	239	119	96	9,641	6,004	62
249	18	18	87	61	626	436	107	92	84	58	3,970	2,798	70
284	18	16	37	27	26	13	202	182	135	109	3,455	2,910	84
16	2	2	.....	.....	67	40	12	.....	80	60	1,349	698	52
175	57	43	105	60	146	67	26	26	154	74	4,604	3,137	68
32	429	395	199	178	3,797	2,888	757	646	434	335	20,881	18,259	87
.....	15	2	32	26	178	100	170	81	14	3	2,231	1,675	75
.....	36	27	121	94	1,495	1,088	189	179	68	42	7,930	5,829	74
293	115	54	79	60	584	349	527	452	381	296	20,689	12,423	60
41	46	29	13	6	153	74	76	31	90	51	3,978	1,683	42
.....	4	4	.....	.....	13	13	.....	.....	8	.....	3,561	1,971	55
99	251	206	407	317	1,668	890	589	459	464	390	30,039	17,200	57
.....	4	4	80	44	370	264	126	100	146	124	31,170	19,688	63
25	13	6	3	.....	232	132	26	13	42	29	8,721	5,012	57
1,309	395	354	124	106	2,176	1,557	854	493	900	522	88,046	61,050	69
96	22	11	83	59	1,067	924	125	100	103	50	17,670	9,523	54
424	55	39	33	17	700	395	183	31	108	50	17,466	8,474	49
92	136	103	232	196	4,337	3,143	1,629	1,044	207	161	27,488	20,392	74
3	64	31	50	44	200	166	89	32	27	16	2,026	1,238	61
80	40	35	83	40	527	435	220	148	96	91	10,913	7,502	69
86	37	24	66	26	3,467	2,519	151	88	109	88	22,647	15,957	70
35	77	72	23	23	2,401	1,398	143	94	87	29	6,164	4,651	75
6	17	15	67	61	139	99	295	170	60	26	7,311	4,816	66
446	6	4	40	40	1,913	1,556	165	120	42	26	8,517	6,438	76
303	73	36	51	44	379	305	270	220	175	133	10,662	6,646	62
13	21	8	124	23	1,419	364	126	32	24	13	21,017	7,948	38
.....	24	9	62	13	384	232	127	19	29	11	6,009	2,052	34
96	2	.....	17	7	237	152	25	25	18	10	10,308	3,479	34
76	15	4	37	26	744	290	50	25	1,075	280	12,298	5,716	46
5,869	9,920	7,020	15,497	11,985	97,488	69,033	33,621	22,229	19,411	13,986	1,345,447	879,522	
	71		77		71		66		72				
	0.7		1.2		7.2		2.5		1.4		Over-all Percentage		65



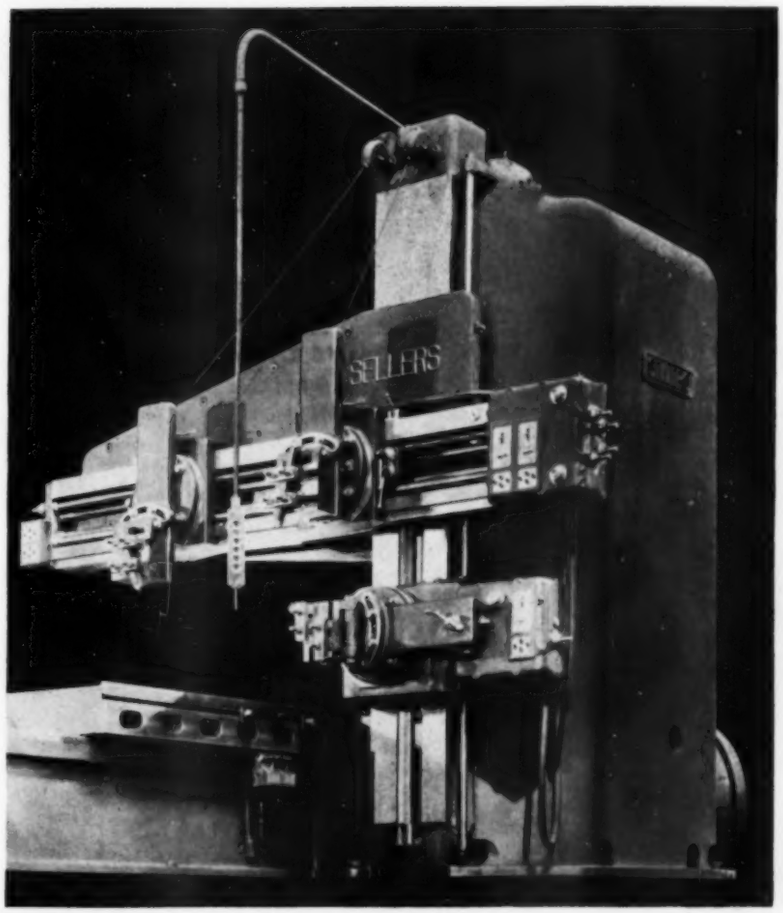


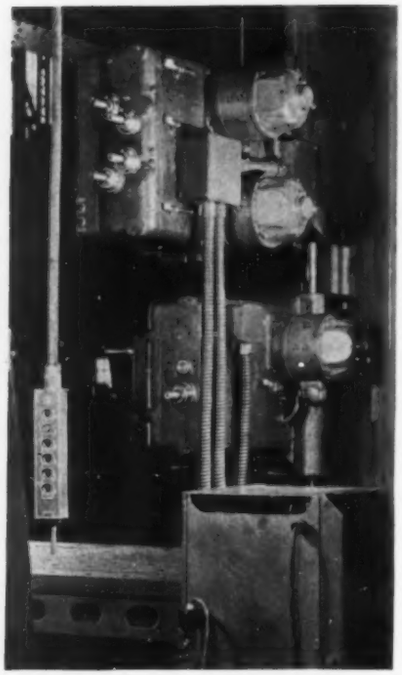
Bird's eye view from the rear showing the huge steel crossrail brace fabricated by Lukenweld. The lifting motor and the mechanism are located on top of the housing. This motor is interlocked with the crossrail clamping motor so that only one push button is required to operate both. That the design is unusually clean and free of unsightly projections is evident from this view and the one below

Simplified crossrail mechanism permits the housing to be of such a shape as to provide maximum rigidity for the face. The entire machine is controlled from devices within reach of the operator. The side head is the same size as the rail heads. Push buttons and toggle switches on each head are placed in a pattern that adds to the ease of control

The rail and side heads are all of the same size and of heavy pattern. All heads are provided with stainless steel scales and adjustable pointers. Hand adjustment of the rail heads is located at the head as well as at both ends of the rail. Micrometer dials are provided at the heads and at the ends of rail. All heads are equipped with electrically operated tool lifters built into the slides. The lifters are operated from the limit switches for reversing the table and may be engaged or disengaged by small tumbler switches located in the rheostat panel. The electrical tool lifters eliminate a great many small levers, racks and pinions required in the mechanical tool lifter.

One of the novel features of this machine is the simplification of the feed and traverse mechanism by means of electrical apparatus. This has made possible the elimination of the ratchet boxes, lost-motion devices, cranks, bevel gears, levers and more or less complicated gear train. Each head has its own motor which provides both feed and traverse. A worm, worm wheel and one pair of spur gears connecting the motor to the screw and spline shaft constitutes the entire mechanical part of the mechanism. The electrical parts include the Westinghouse measuring relay, two magnetic





Feed and traverse motors are mounted on the back of the heads. The box in the foreground contains electrical controls for the tool lifters and the high and low cutting speeds

clutches, two elevator car switches for feed and the necessary push buttons for traverse. All the electrical parts are built into the mechanism boxes and not added on the outside. When several heads are operated simultaneously each may carry a different amount of feed.

The main drive control is of the full magnetic type and provides overload and low voltage protection. This control system provides a self-excited dynamic braking circuit which will cause the platen to stop faster on emergency braking than on normal operation.

A line contactor always closes prior to the closing of the directional contactors. This precludes any possibility of the line contactor welding since it never closes a circuit while carrying current. If the directional contactors weld the line contactor will open the circuit. Stroke limit switches for automatic control of the reciprocation of the platen makes it possible to operate the platen at high speeds. Complete control of the normal machining operations are centralized in the pendant station. The operator does not have to manipulate any other levers or switches after the job is set up. The pendant station contains six buttons and a stop lever.

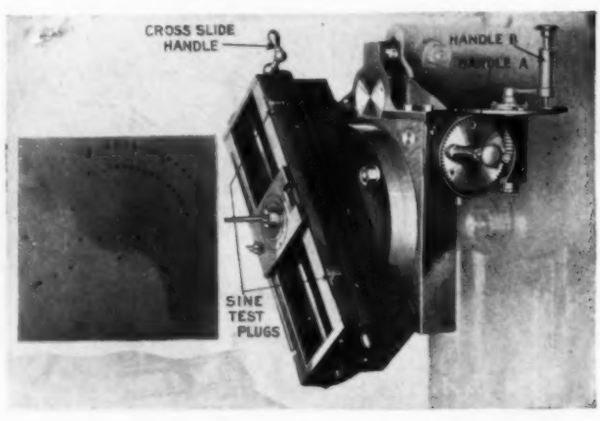
The rheostats for adjustment of the speed of the main drive motor are contained in the operator's control station. Two rheostats are provided, one for adjustment of the cut speed, the other for adjustment of the return speed. In addition to the rheostats there is a selector switch provided for the selection of the cutting speed range. The operator's control station is arranged for separate mounting. Thus, it may be mounted at a location convenient to the operator while the main control panels are mounted at a remote location where floor space is not so valuable. In addition to the rheostats and the cutting speed range selector switch, the operator's control station also contains a selector switch for selecting the end of the stroke at which the feed will take place, the control switches for the magnetic tool lifters and the "tarry" selector switch.

The Westinghouse measuring relay is the heart of the electric feed control. This device is a development which controls the amount of feed governed motion of the feed screw. The device is mechanically coupled into the feed drive and is in effect an adjustable limit switch driven by the feed drive. It may be adjusted for any setting from 0.001 to 1 in. by movement of the dials which may be seen at the end of the cross-rail and on the side head. When the feed motor starts the measuring relay is driven for a certain number of revolutions as determined by its setting, its contacts then open and cause the motor to stop. Thus, the feed is definitely and accurately controlled by the movement of the head or slide as the case might be. This planer feed does not depend upon any timing devices of any kind.

The tarrying device is particularly useful in working in pockets or in places where there is not room to allow sufficient overtravel so that the feed will be completed before the tool enters the work or where the stroke is too short and the feed too great to allow the feed to be completed during the return stroke. While it is possible to have the feed take place at either end of the stroke or at both ends for large feeds, there are times when it is desirable to feed at the beginning of the cut stroke and there is not room for sufficient overtravel. The tarry will cause the platen to stand still until the feed has been completed and then automatically resume its motion.

"Production" Universal Jig Boring, Drilling and Milling Attachment

The Production Machinery Sales Co., Inc., 4845 St. Aubin Ave., Detroit, Mich., has developed a jig boring, milling and drilling attachment, known as the "Universal." The attachment is arranged to fasten to the column of the milling machine and over-arm, the base being adapted to the particular size of the machine to be used. A main gear, which is adapted to the spindle of the milling machine, drives the boring spindle through bevel and spiral gears. Movements of the traveling spindle are two, radially in the slide which in turn has a circular movement imparted by a series of worms and gears, so that any angle can be obtained. When in place it is rigidly supported and forms an integral part of the machine. Any angle to the second may be obtained by the dividing apparatus. The spindle is provided with a tapered front bearing adjustable for wear, and provision is made to keep backlash out of the dividing worms. Radial adjustment is made by means of a vernier and scale, and the angular adjustment is made by means of the chart supplied for the machine. A feature of the tool is the chart. When set at any desired angle, it reads, on the opposite side, the exact movement of the dividing gears necessary to set the boring head at the required angle. This eliminates all necessity for calculating angles.



Adapted to fasten to the column and overarm of the milling machine, the attachment spindle moves in the slide which in turn has a circular movement

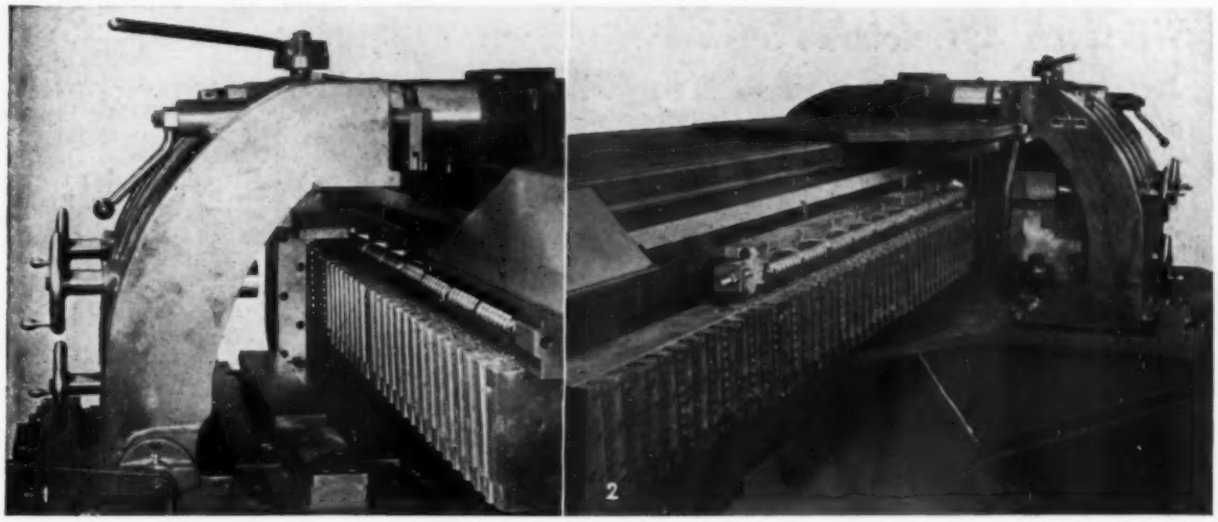


Fig. 1—Four surfaces in a six-cylinder block are broached in this special Cincinnati Broaching Machine using tools made up of circular and flat blades. Fig. 2—Broach ram run out to left end. A tungsten carbide finishing blade is used in each row of flat blades

Cincinnati Special Horizontal Broaching Machine for Cylinder Blocks

The Cincinnati Milling Machine Co. and Cincinnati Grinders Incorporated, Cincinnati, Ohio, have furnished a large automobile manufacturer a special horizontal surface broaching machine, for broaching the manifold-joint face, valve-chamber cover pad, fuel-pump pad, and a long narrow pad immediately below the valve chamber, on a six-cylinder block. The machine was built to accommodate a 32-in. conveyor height, so that the work enters the fixture directly from the conveyor. A bar, which locates from the previously broached bearing lock, guides the cylinder block into the tunnel-type fixture. This guide bar is moved forward by means of a lever, and simultaneously with this movement, two dowel pins rise and accurately position the cylinder block. Three adjustable stops, movement of which is provided by three handwheels, support the work against side thrust or thrust normal to the broaching cut. The locating dowel pins are free to move in the direction of the broach travel, so that the cylinder block is positioned against the fixed end stop.

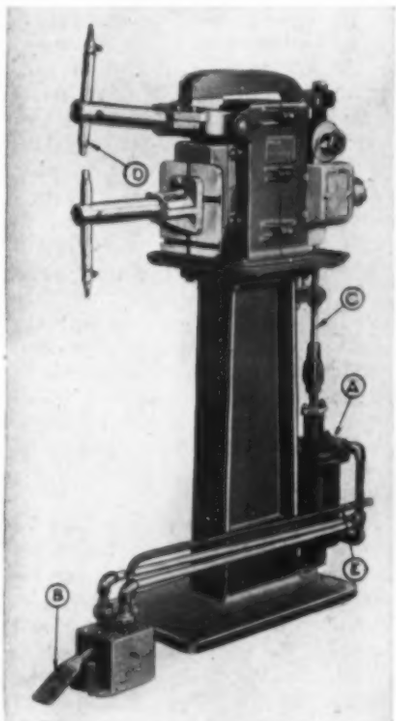
The ram control lever and the positioning lever are hydraulically interlocked, so that the forward ram movement of broaching stroke is obtained only when the positioning lever is in the "in" position, and return movement, only when the position lever is in the "out" position. Tie-bolts over the top hold the fixture rigidly to the bed frame. The outstanding features of the machine are its hydraulic control, cast construction, rigidity and smoothness of operation.

The cycle of operation is to position work toward the ram for broaching, simultaneously raising the locating dowels; clamp, bringing up adjustable stops; broach; release work and clear from ram; return ram.

Cutters are as follows: special high-speed steel circular broaching tool capable of being turned 180 deg.; two rows of high-speed steel inserted blades with 40 blades for roughing and semi-finishing and one tungsten carbide finishing blade in each row. Broaching speed 25.2 f.p.m.; stock removal 0.200 in.; time per piece, 0.84 min.; production 55 pcs. per 48 min. hr.; total area broached, 37.6 sq.in.

Eisler Air-Operated Electric Spot Welder

Electric spot welders which utilize air pressure for closing the electrodes upon the work have recently been developed by the Eisler Engineering Co., 768 South 13th St., Newark, N. J. Available in sizes from 5 to 75-kva. and capable of welding metals up to 0.750 in. in thickness, these welders, because of the particular design of the air cylinder, require a very small volume of air for operation. Air pressures up to 80 lb. are used, the pressure depending upon the size of the welder used. Upon pressing the foot controlled valve *B*, air from the supply line *E* is admitted into the cylinder *A*. The piston imparts motion to the electrode *D*, through the vertical drive shaft *c*. The use of air-operated welders permits, by means of a regulating valve in the supply line, exact regulation of the electrode pressure.



Giddings & Lewis Precision Horizontal Boring, Drilling and Milling Machine

Quill-type heads, which include a boring bar with hand and power feeds, are the outstanding feature of a high-power, precision, horizontal boring, drilling and milling machine announced by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. The quill in these heads is adjustable by hand and also has eighteen independent power feeds. The boring bar slides in a sleeve driven by the bull gear. Instead of mounting the spindle in the headstock proper, it is carried in anti-friction bearings within the adjustable quill and the drive is modified to suit the in-and-out movement of the quill. Moreover, 8-in. and larger milling cutters may be mounted on the spindle sleeve and left there because the spindle is free to pass through the cutters.

For heavy duty milling the quill is moved out until the cutter is properly set. After roughing, a finish cut can be taken by adjusting the quill the proper amount. To facilitate precision settings for depth, a hardened steel block is attached to the front cover plate of the quill. Inside micrometers or other measuring devices may be used between this block and the head proper.

Quill Controls

Both hand and power adjustment of the quill is effected by means of the regular spindle feed mechanism. A small "feed selector" lever is thrown to the left to connect the turnstile mechanism to the quill. With the levers of the turnstile pushed in, hand feed to the quill is engaged; by pulling them out the power feed is engaged. By placing the feed reverse lever in neutral, micrometer hand feed adjustment to the quill is available by means of the handwheel. A depth gage and automatic trip feature operates with the quill in the same manner as with the spindle. To prevent damage when overrunning, the quill rack terminates in ratchet teeth, one at each end, which automatically cut out the feed but permit the quill to be picked up again by merely operating the turnstile in the opposite direction.

Directional controls are provided for the heads and the table. Table and heads may be started, stopped and reversed singly, or together, and are independent both in regard to time and direction. No matter whether feed or rapid traverse is engaged, whether the spindles are running clockwise or counter-clockwise, the units always move in the direction their respective levers are actuated. This independent action enables an operator to follow an irregular outline by using power feeds to the table and horizontal heads for vertical surfaces, or to the table and vertical heads for horizontal surfaces. Each of the heads, as well as the table, has eighteen feeds, which make it possible to face mill surfaces such as flanges, pads, and others that run at an angle with the top of the table, by engaging the two particular feeds that come nearest to giving the proper slope. In all, 324 combinations can be directly engaged, sloping up and sloping down.

Rotation of the turnstile rapid traverses either the spindle or the quill by hand. A pull on any one or several turnstile handles engages the power feeds; a push or tap disengages them. With the feed reverse lever in neutral, micrometer hand feed adjustment either to the spindle or the quill becomes operative through the hand wheel next to the quill. By clamping the dial ring in position corresponding to the depth to the drilled, a trip is engaged to disengage the feed within a 6-in. stroke.

By cranking the lever of the spindle speed selector or that of the feed selector, forward or backward, nine changes of speeds or feeds are obtained. A single backgear for the feeds doubles up the number, giving eighteen independent feeds, while two sets of backgears in conjunction with the speed selector provide 36 separate spindle speeds. Beneath the cover plates, geared to the rotary selectors, are dials which, through openings, show the spindle speed or feed engaged. While cranking, the operator merely watches the window until the speed or feed wanted appears. With the backgear lever to the right the right-hand rows of feeds apply, and vice versa.

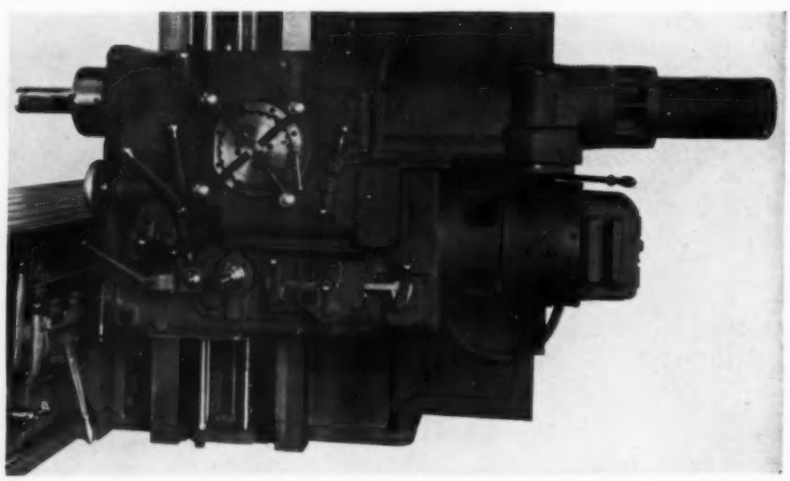
Safety trips limit the movement of the various units in all directions. The entire design is coordinated in such a manner that whenever the table or one of the headstock units run on to a trip the operator can back off again under power by merely reversing the direction of feed.

Over-run Protection

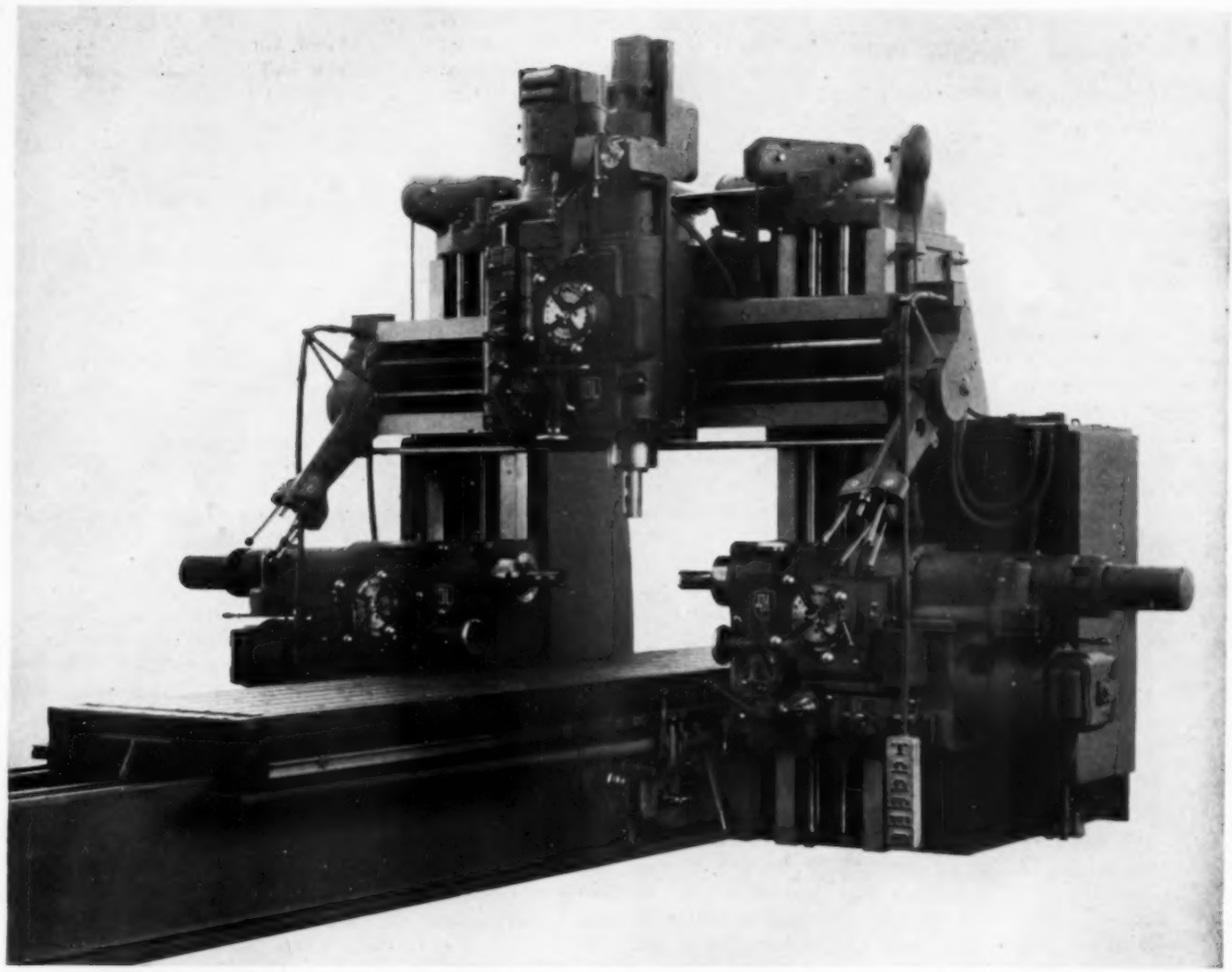
Both the spindle and the quill are protected in their end positions by ratchet teeth. Should the pinions run off the racks the operator need only reverse the direction of the movement of the turnstile which will then automatically pick up the racks again.

The table is provided with two sets of scales and verniers, one on each side, and each headstock is equipped with an individual vernier and separate scales if necessary. All verniers are adjustable and can be set to the nearest full inch, which eliminates a lot of decimal figuring. They are graduated to read in 0.001 in.

The two planer-type cross rail clamps are operated simultaneously from either side of the machine. The motor on the cross brace between the columns, controlled from either of the two push button panels, raises and lowers the arm. The vertical movement of the rail is protected by safety trips. One at the top of the column prevents



Close-up of motorized head showing the controls for operating the spindle or the adjustable quill by hand or power. Eighteen power feeds can be applied



Giddings & Lewis Horizontal Boring, Milling and Drilling Machine having two side heads and one vertical head. This type of machine can be furnished with various multiple head combinations

overrunning when raising the rail, while two, one on each headstock, limit the movement when lowering, tripping the rail on that headstock which happens to be in the highest position.

Little difference exists between the horizontal and vertical headstocks. Directional control of the movements of the head on the rail is retained. For convenience the spindle clamp lever has been extended on an adjustable spring counterbalance, acting both on the spindle and the quill, is incorporated in the ram guide. The hand crank permits adjusting the tension on the counterbalance to compensate for the difference in weight of milling cutters, boring heads and other tools.

A three-head machine is shown with duplex controls. Not all combinations permit such an arrangement and for certain classes of work complete duplex control is not desirable. The various motors are electrically interlocked. Each headstock is driven by a separate motor; the table drive is a separate motor driven unit; the rail is raised and lowered by a separate motor, and the oil and coolant pump are individual motor driven units. A separate portable push button panel is located on each side of the machine and arranged to perform the following functions: emergency—stop; rail—up—down; table feed motor—start—stop; right-hand head motor—left—stop—right; vertical motor—left—stop—right; left-hand head motor—left—stop—right. Mechanical controls are also carried to the opposite sides of the machine.

Specifications

Specifications for the standard 30-series multiple head machines are as follows: No. 340-PQ—diameter of spindle, 3½ in.; diameter of adjustable quill, 9½ in.; maximum adjustment of quill, 8 in.; diameter of face of spindle sleeve, 6 in.; minimum milling cutter size, 8 in.; longitudinal travel of spindle, horizontal heads, 24 in., vertical head, 18 in.; range of spindle speeds, 7.5 to 450 r.p.m.; range of feeds to quill and spindle in in. per revolution, 0.010 to 0.500 in.; working surface of table, 48 in. x 12 ft.; cross feed of table, 120 in.; width of bed, 34 ¼ in.; maximum distance from top of table to center of horizontal spindles, 40 in.; maximum distance from top of table to spindle sleeve of vertical head, 48 in.; maximum cross travel of vertical head on rail, 56 in.—The No. 350-PQ—diameter of spindle, 4½ in.; diameter of adjustable quill, 11½ in.; maximum adjustment of quill, 9 in.; diameter of face of spindle sleeve, 8 in.; minimum milling cutter size, 10 in.; longitudinal travel of spindle, horizontal heads, 30 in., vertical head, 18 in.; range of spindle speeds, 6.25 to 375 r.p.m.; range of feeds to quill and spindle, 0.010 to 0.500 in; working surface of table, 60 in. x 14 ft.; cross feed of table, 144 in.; width of bed, 40 in.; maximum distance from top of table to center of horizontal spindles, 52 in.; maximum distance top of table to spindle sleeve of vertical head, 60 in.; maximum cross travel of vertical head on rail, 66 in.

High Speed Special No. 5½B Riveting Hammer

Trimmed butt welds on sheets of No. 20 gage steel used in the manufacture of automobile bodies are being flattened at the rate of 70 in. per min. in one plant by the use of special machines recently built by the High Speed Hammer Co., Inc., 305-321 Norton St., Rochester, N. Y. On these sheets the riser, which has been trimmed, averages about 0.004 in. per side. The hammering operation quickly reduces this thickness to the gage of the metal. Production time depends upon the amount of material left for flattening after the trimming operation, and on the gage of the sheet. In the method of manufacture previously followed in this plant, two stampings were cut out and welded together after the forming operation. A portable tool was then employed for removing the excess welded material, and there was always danger of marking the sheet or removing more metal than was desirable. Grinding to clean up the welds also had the same drawbacks.

With the method employed at present, two flat sheets are butt welded together, and the flash is then removed by a standard flash trimming machine, after which the sheet is given a uniform thickness throughout by one of the high-speed hammering machines. Welded sheets are now stamped and formed without danger of the weld opening or fracturing. These hammers are built with a gap to accommodate various widths of sheets. The handling of the large welded sheets is facilitated through the use of roller tables or ball transfers constructed on each side of the machine.

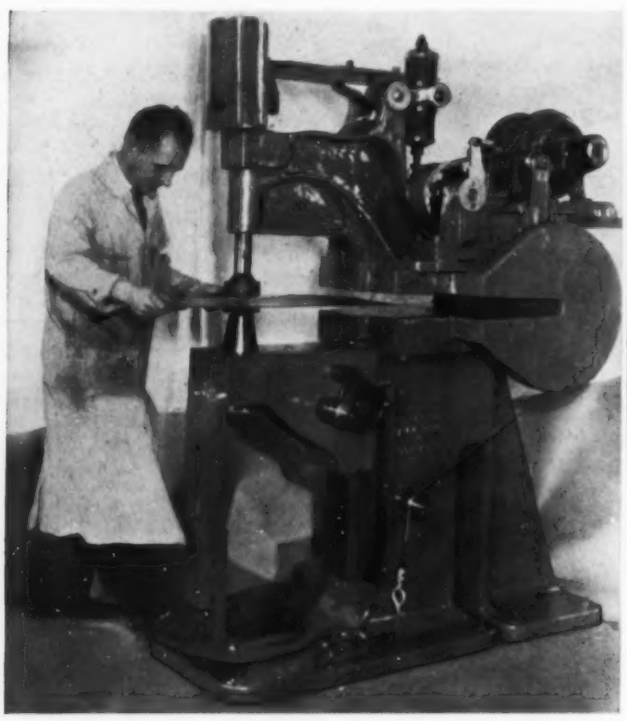
National Open-Die Cold Header

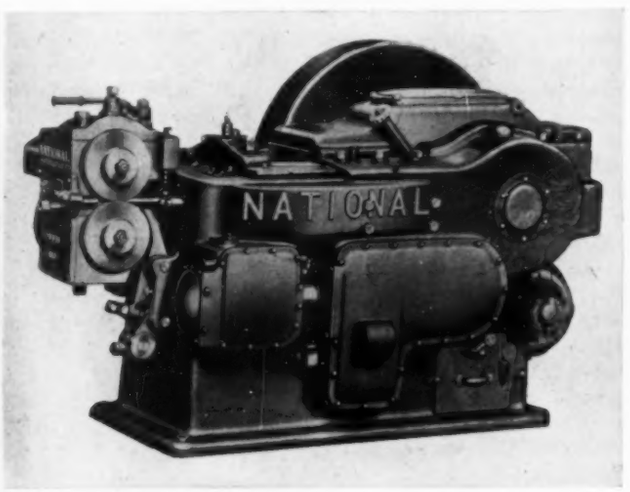
The National Machinery Co., Tiffin, Ohio, has announced a line of open-die cold heading machines, similar in design to its solid die machines, with the addition of a relieving grip motion which enables the machine to operate either as a relieving-grip or solid-die machine. They will produce long or short, open or solid, die work with equal facility, all of which can be extruded during heading for roll threading. Wire is fed through a shearing bush, cut off, carried on over, and pushed back into the die just as in the case of a solid-die machine. At the time of heading, the dies are originally held together by the gripping mechanism, but as soon as the heading is completed, before the kicking starts, the grip is slightly released. Regardless of its length, the blank is easily ejected from the dies. The grip mechanism is toggle operated, and protected by an automatic release.

It is only necessary to change the stroke of the wire feed and adjust the position of the knock-out pins to make all lengths in the same die, within the range of the machine. There is almost a total absence of part-line fins; the heads are central, and the diameter under the head is accurate and uniform.

By means of an adapter, the machine can be equipped with solid dies. When solid dies are used, the grip is locked in closed position, so that the die is rigidly held in alignment. This is accomplished by a locking screw conveniently located on the top of the machine. The machine may also be operated with split dies which are clamped solid. In this way, the machine can be operated as a solid-die header with split dies on extremely long work, as long as no trouble from ejection develops. If, however, such trouble is encountered, it can be eliminated by opening the grip actuated screw which permits the machine to operate as an open-die header, and which relieves the pressure on the work before ejection occurs.

In the National type of open-die headers, that portion of the shank to be roll threaded can be reduced by the process of extrusion, simultaneously with the heading.





Above—Such standard features of the National Cold Header construction as long over-arm heading slide, oscillating cut-off and rocker heading tool movement have been retained

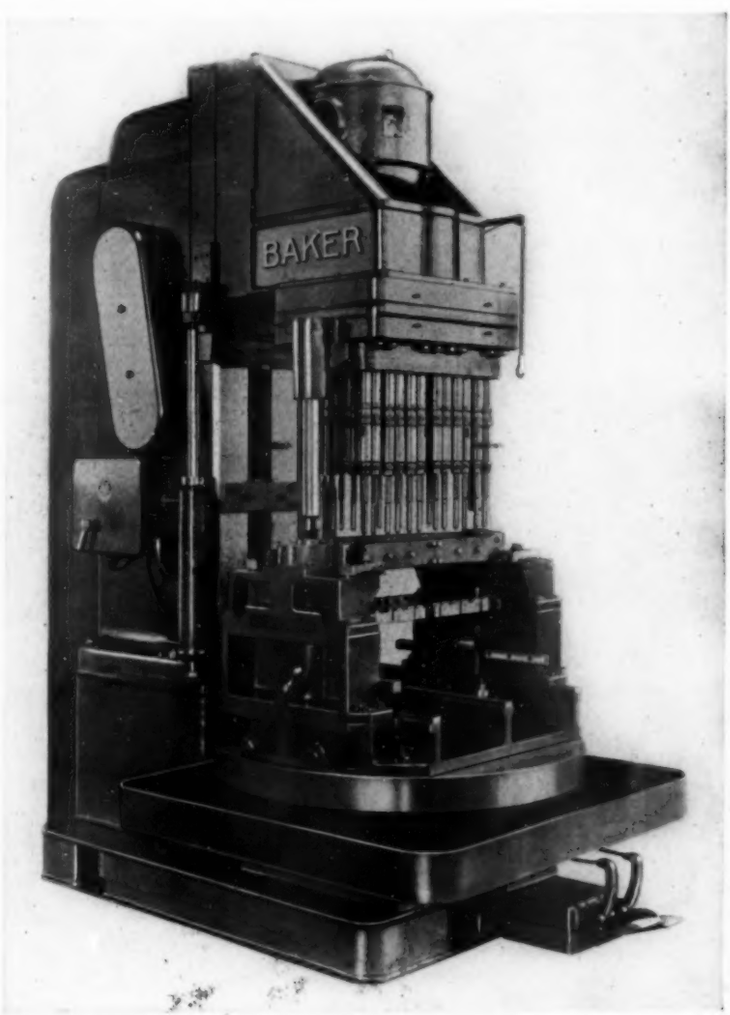
Left—After the butt-weld riser is reduced to gage thickness by the High Speed hammer, the sheets are ready for finishing without soldering, filling or filing

Baker No. 30-HO Hydraulic Feed Vertical Multiple-Spindle Machine

Baker Bros., Inc., Toledo, Ohio, has designed a vertical hydraulic feed machine of simplified drive, for second boring and reaming valve guide holes, and finish boring valve throats and chamfering the valve seats on a six-cylinder block. The cycle is automatic, allowing for one or two feeds in connection with a positive stop and delayed reverse for facing and like operations. Rigidity is provided in the main column to allow for accuracy of operations with overhangs required in connection with large-size, multiple-spindle heads. Hydraulic feed and oil pumps are contained in the main frame with a self-contained motor drive. The saddle, on which the head bracket is mounted, is 40 in. in length and is arranged with taper take-up gibs between the way of the main frame. A motor for driving the spindles in rotation is mounted on the saddle bracket with a direct coupled drive to the main driver shaft in the multiple head.

All spindles are mounted on ball bearings with vertical adjustments in all spindle ends and with provision for lubrication to all bearings and gearing in the head. The head is arranged with 24 spindles, a front row of twelve spindles, which carry the final reaming and chamfering tools, and a rear row for the twelve guide and valve throats. The head drive is of the simplified type. However, this machine may also be furnished with a standard top driving bracket mounted on the top surface of the column, this bracket being arranged with pick-off gears in the speed train to allow for changing of speeds to the main vertical drive shaft. On completion of the chamfering operations the head automatically returns to its upper position and stops.

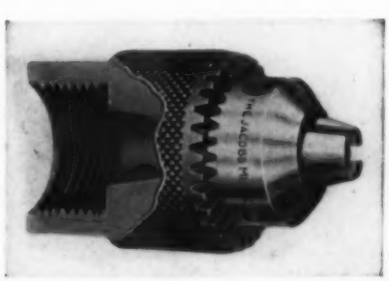
A two-station hand-indexed table is mounted on the base and carries a fixture arranged for chucking two blocks. Tools are supported at the top by bushings as well as by pilots at the bottom. Blocks are located in the fixture from two dowel pins of the disappearing type, controlled by a lever mounted on the side of the fixture. Two clamps are provided for holding the block in place. Production on this machine is 30 blocks per hour.



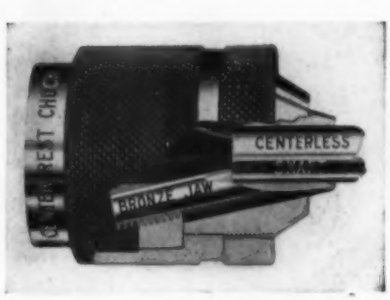
Standard length of travel on the Baker No. 30-40 machine is 16 in., but increased length of travel may be furnished, if desired

Jacobs Lathe Headstock and Center Rest Chucks

The Jacobs Mfg. Co., Hartford, Conn,. has announced lathe headstock and center rest chucks designed for toolroom jobs, turning centerless shafts and commutators on armatures. To secure good results in turning commutators, it is necessary to hold the armature shaft at the bearing point, even though the shaft may originally have had center holes. These center holes cannot be relied upon for re-turning. The headstock chuck accurately drives the shaft in the lathe. The center rest chuck fits the tail stock by means of an arbor, and the armature



This model screws on the spindle of small lathes

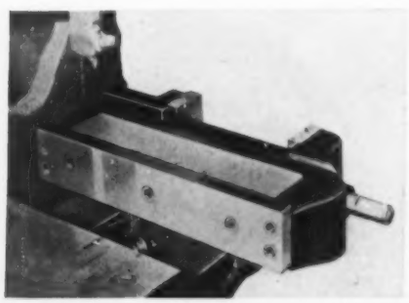


Center rest chuck jaws are adjustable from ½ to ¾ in.

is held on the bearing surface in bronze jaws. Concentricity is secured by this means, as the turning is done true to the bearings. Chuck jaws are adjustable from ¼ to ¾ in. Headstock chucks can be furnished to thread directly to the spindle of small lathes. A hole through the body permits the insertion of valves or other round work for grinding. It is available in seven models, capacities ranging from ⅛–⅝ in to $\frac{3}{16}$–¾ in.

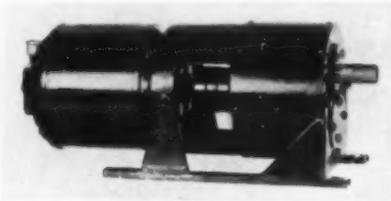
"Handy" Shaper Vise Attachment

The "Handy" shaper vise attachment, a development of the National Machine Tool Co., Racine, Wis., permits changing from end-shaping to ordinary shaping without changing the position of vise, or raising and lowering of the main table. Long pieces may be end-shaped to positive squareness and length without difficulty. Overall dimensions may be taken with micrometer or vernier without removing the work from the vise. The vise is made in two models, having jaw openings of 6 in. for 16 to 20 in. shapers, and 8 in. for 24-in. stroke shapers. A complete shaper vise provides the same facilities as the attachment shown, but consists of two vises. The two sets of jaws are at right angles; one horizontal, the other vertical.



"Lectrigear" Helical Gear Reduction Units

The Ajax Flexible Coupling Co., Westfield, N. Y., announces a helical gear reduction unit called the "Lectrigear," to be made in sizes ranging from ⅛ to 2 hp. Standard footless motors are used without any changes in shaft or bearings. Lectrigears can be furnished either with or without motors. It is unnecessary to use specific makes of motors.



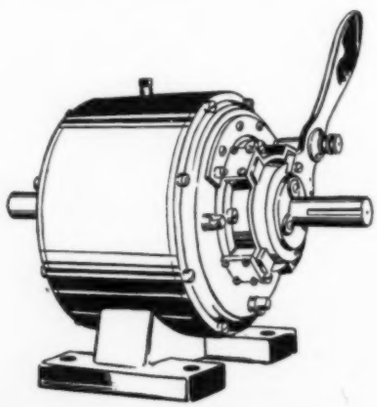
Koebel Diamond Dressers

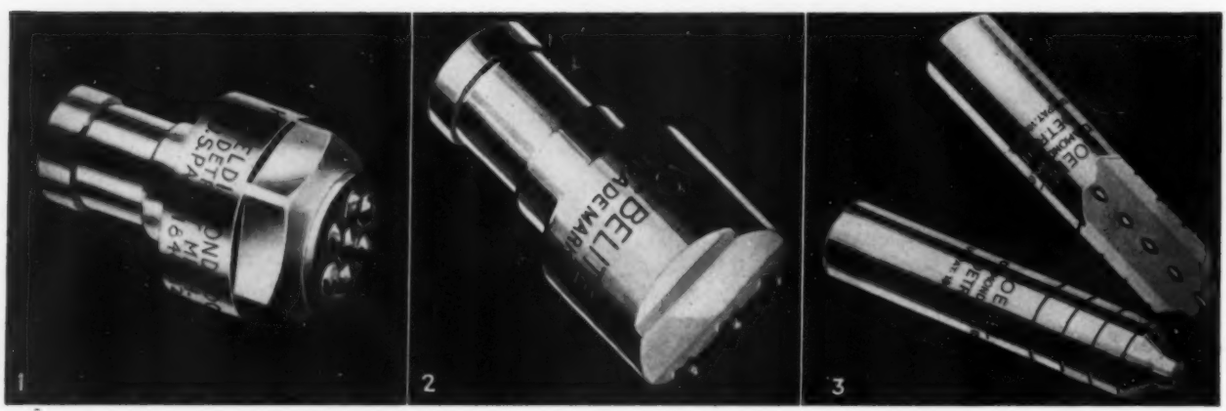
The Koebel Diamond Tool Co., 1200 Oakman Blvd., Detroit, Mich., has placed on the market a line of diamond dressing tools. The diamonds are embedded in "Koebelite," a metal which fuses below the critical temperature of the diamond and has practically the same coefficient of expansion as the diamond. The fusing is done in a hydrogen furnace, thereby avoiding a film of oxide forming between the diamond and the metal. Koebelite will not load or glaze the wheel, but grinds away freely as the diamonds wear. Fig. 1 shows the "Multi-Point" tool which brings from two to five diamonds in contact with the grinding wheel. This results in each diamond taking its share of the burden. The traverse can be speeded up faster than with a single-point tool. For an equivalent dressing the multi-point tool will hold size across any width of face. Multi-Point tools may be used to advantage on the centerless grinder, where high finish is required. The "Multi-Edge" dresser, Fig. 2, is traversed with all three diamonds in contact with the grinding wheel, thus producing a high finish on the work. Three, four or five diamonds are mounted in line in spaced relationship in the "Multi-Stage" dresser, Fig. 3. After the first diamond is used up, the holding metal is turned or ground back to expose the next diamond. Grooves show approximate location of each successive diamond point.

Fig. 1 — "Multi - Point" Diamond Dresser for high-finish grinding. Fig. 2—"Multi-Edge" Dresser for high-finish grinding. Fig. 3—"Multi-Stage" Dresser which has several diamond points for progressive consumption

Ganschow Variable-Speed Reducer

A variable-speed unit having a positive reduction drive has been developed by the Ganschow Gear Co., 1013-15 Washington Blvd., Chicago, Ill. Gears will not jam when shifting from one ratio to another by means of the cam shifting device. These units have standard ratios of 4, 5, 6 and 7¼ to 1, in sizes from ½ to 25 hp.





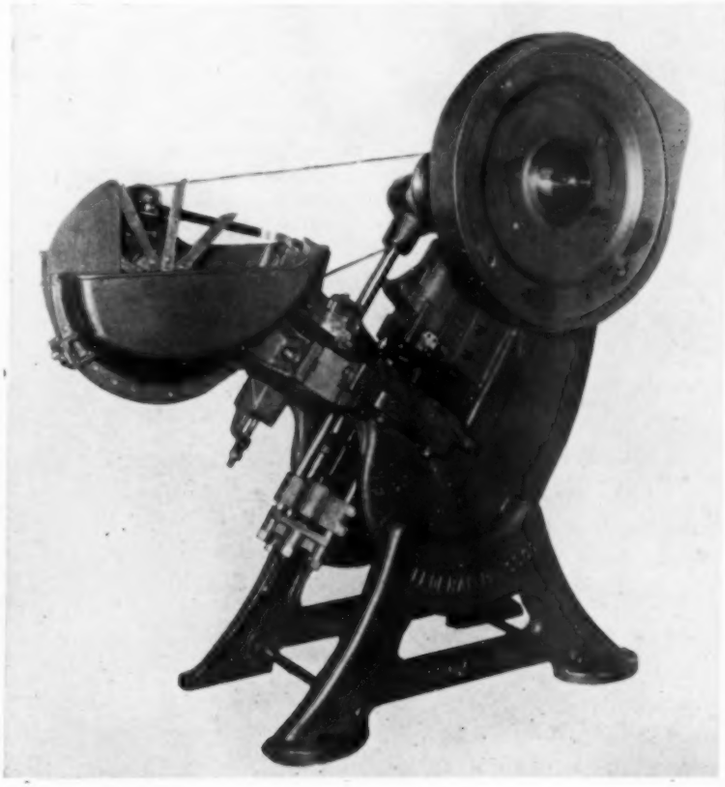
Federal No. 3 Capscrew and Bolt Trimming and Extruding Machine

The No. 3 trimmer, offered by the Federal Press Company, Elkhart, Ind., is a high-speed machine for automatically trimming capscrews and bolts, and is also used for extruding. The machine illustrated will handle blanks from ½ to 2½ in. in length on all diameters ⅜ in. and smaller at the rate of 140 blanks per min. Other sizes are also included in the line.

The frame, flywheel and ram of this machine are built on the lines of standard punch presses. The machine is inclined at 35 deg. with main bearings for crankshaft and ram above the point of operation where they are protected from chips and grit. The flywheel is mounted between two friction disks with a wedge take-up which eliminates possibility of a sprung crank shaft in case the machine should come to a sudden stop. The hopper is paddle wheel type and will feed to capacity all sizes and lengths within the range of the trimmer.

Several features have been obtained by inclining this machine at 35 deg. from the vertical. The natural position of the blanks, coming down the raceway to the tools, is at the same incline. This position is maintained in transferring the blanks into the tools, which assure short transfer movements and high speed. The blank transfer mechanism consists of two levers operated by direct roller contact with the cams. One lever operates the cradle for the blanks coming from the raceway, and the other lever carries the pick-up fingers which bring the blanks into the tools. Knocking the blanks out of the punch after trimming is accomplished on the upstroke by a bar extending through the bolster plate of the machine. This bar carries an adjustable lug which acts directly on the knockout pin.

A patented feature of this machine is the device for shearing the chips from the screw head at the time that the punch and die have approached one another to crankshaft center position, with the chips pinched between punch and die. Pressure is then brought to bear on the end of the blank sufficient to separate the chips from the screw head which results in a clean trim with no drag or burrs on the under side of the screw head. Levers ordinarily used are discarded.



Vickers Electric-Hydraulic Control Panels

Vickers, Inc., 1410 Oakman Blvd., Detroit, Mich., has developed an electric-hydraulic control panel that will give practically any combination of automatic feeds and rapid traverses. Starting, reversing and stopping are controlled electrically by pushbuttons or limit switches, relays and solenoids built into the panel. A synchronous time-relay which is easily varied by

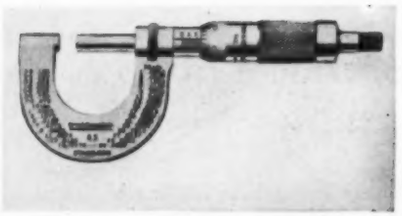
turning a dial in the panel provides delayed reverse. The different feed rates and rapid traverses are controlled hydraulically, being increased or decreased by stops on the work table that depress one or the other of the two center plungers. The length of any working stroke or rapid traverse is varied by changing the position of stops. A lever provides manual control for set-up purposes.

Mercury Type D Gas Tractor

The Mercury Manufacturing Co., 4118 South Halsted St., Chicago, announces a Type D gas tractor equipped with large size pneumatic tires, front and rear. Dual rear tires provide increased traction and cushioning effect. Overall length is 86 in., width, 60 in., and outside turning radius, 115 in.

Brown & Sharpe No. 8S and 10S Micrometer Calipers

The Brown & Sharpe Mfg. Co., Providence, R. I., has announced the inclusion in its line of micrometer calipers Nos. 8S and 10S, developed to resist wear and stain. The threads of the measuring screw are ground in a one-piece hardened spindle of high chromium, high carbon steel. This steel is also used in the anvil. Stainless steel is used for the frame, thimble, barrel and all of the unhardened parts. As an aid to easy and accurate reading, the thimble has large figures, which are placed on a non-reflecting background. The No. 8S is made to measure 0 to 1 in., by thousandths of an inch. The No. 10S measures 0 to 1 in. by ten-thousandths, as well as thousandths of an inch. Both tools can be furnished with or without ratchet stop.



The Brown & Sharpe caliper is made to resist wear and stain

Zeh & Hahnemann press, of sturdy construction, with a non-repeat clutch

Zeh & Hahnemann Improved Reclinable Press

The main features of an improved line of reclinable power presses announced by the Zeh & Hahnemann Co., 180 Vanderpool St., Newark, N. J., are the construction of slides with round shank holes and the use of a one-half round clamping cap. Other characteristics are a non-repeat clutch, web-type self-lubricating full-bearing flywheels, 40 deg. inclination, treadle-operated loop guard and treadle guard.

A steel cap protects the end of the gear case

"CP" No. 815 Universal Electric Drill

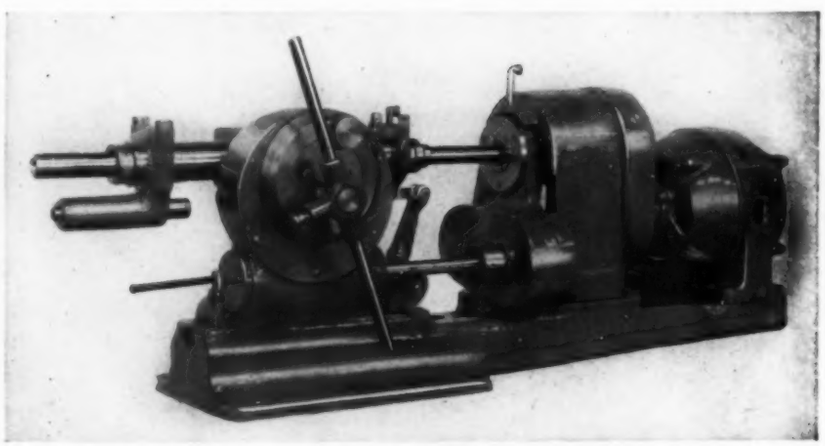
A ¼ in. electric drill is being offered by the Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y. This No. 815 universal tool can be had with a free speed of either 5,000 or 3,700 r.p.m., and loaded speeds of 3,200 and 2,300 r.p.m. respectively. The weight of either model is 4 lb.; length overall, 7½ in., spindle offset, $\frac{31}{32}$ in. A screened intake excludes dirt and chips. Brush holder and brushes may be inspected with the motor running by removal of the cap. Ball bearings with felt seals are employed throughout. The chuck is balanced and has a smooth body. It screws onto the threaded spindle.

Houghton High Film-Strength Cutting Oils

A series of straight cutting oils combining refrigeration and high film strength have been announced by E. F. Houghton & Co., 240 West Somerset St., Philadelphia, Pa. The oil is fluid so that it will penetrate quickly back of the cutting edge of the tool, and has high strength to withstand extreme pressures exerted on the tool. It is said that the physical and chemical properties are such that they will remain the same over a long period of time. These qualities are built into the straight cutting oils now available, including Super Refrigerant Base and "Frapol" No. 414 and No. 418. It is understood that these oils will withstand full loads on standard Almen and Timken testing machines, thus meeting the requirements of film strength because of the extreme pressure resistance which has been given them.

Edlund Motor-Driven Drill Units

The Edlund Machinery Co., Inc., Cortland, N. Y., has supplemented its line of drilling machines by the addition of hand feed and power feed individually motor driven drill units. These units may be mounted vertically, horizontally or at an angle for drilling holes in different planes from the main machining operation, or may be used in groups for drilling two or more holes. A motor drives the spindle through a pair of helical quick change gears and a two-spline broached quill. On the power feed unit a four-step cone pulley is mounted on this quill for driving the power feed mechanism. As the drill is advanced and comes in contact with the work the feed automatically engages. A dial gage is provided to de-



The hand feed unit eliminates the feed box and pulleys

termine the depth to be drilled before a stop disengages the feed and the spindle returns. The feed may be disengaged at any time by raising the feed lever. This unit has a capacity of ¾ in. in steel and a spindle speed range from 360 to 3,000 r.p.m. Feeds of 0.002, 0.0035, 0.006 and 0.010 per revolution are provided.

Hobart 75-Amp. Arc Welder

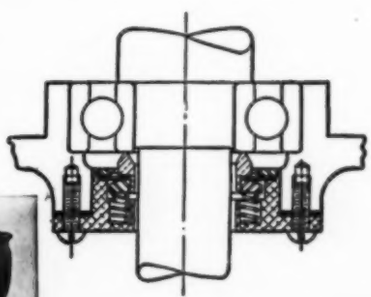
Rated at 75 amperes, 25 volts, being designed especially for light gage welding, this welder, announced by the Hobart Co., Troy, Ohio, has a welding range of 15 to 125 amperes in three steps. It performs well on 24 gage and heavier, using 1/16 in., 3/32 in., or ⅛ in. electrodes, either bare or coated. Power is by a 3-hp. electric motor. Standard equipment includes a starting switch, polarity change switch, dual remote control, double reading voltmeter and double reading ammeter. The reactance unit is inclosed in a pressed steel "Turret Top." Arc welded steel construction is used throughout. Motor, generator, and exciter, with special cooling fan, are ball bearing mounted.

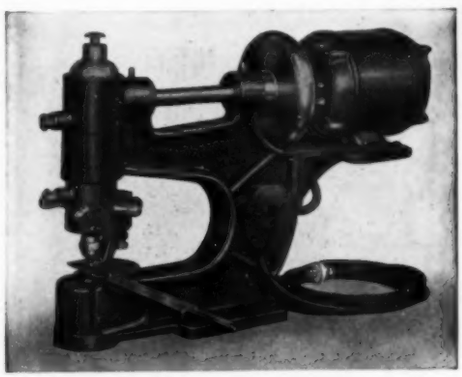
Savage No. 109 Nibbler

The No. 109 nibbler, manufactured by the W. J. Savage Co., Knoxville, Tenn., is streamlined and has no moving parts in front except the cutting tool. It has a capacity of ⅛ in. in mild steels, and 1/16 in. in tough alloy steels, and is designed for both templet and line cutting. Specifications are as follows: throat depth, 9 in.; feed, 36 to 60 in. per min.; net weight, 125 lb.; repulsion-start induction motor, ¼ hp. Adjustable tools and dies, revolving head, and adjustable ram bushing are other features.

The grinder motor draws small amount of current, at start and running

An economical speed of 1,750 r.p.m. is maintained in the Hobart Arc Welder, and assures long life





Above — Flange-style "DM" seal applied to ball-bearing inner race face on a vertical shaft installation. Right — These seals are being used in high-speed installations

Baldor Bench and Pedestal Buffers

The Baldor Electric Co., 4357 Duncan Ave., St. Louis, Mo., announces the development of a line of ball-bearing buffers, both bench and pedestal types, in sizes ranging from ½ to 5 hp. Features of the line are as follows: large ball bearings, extended end bells, long distance between wheel centers, heavy shaft, minimized vibration and totally inclosed motor. Models are available for two- or three-phase, 220 or 440 volts and single-phase, 110 or 220 volts, not interchangeable.

Gits Oil Seals

High-speed seals, manufactured by the Gits Bros. Mfg. Co., 1859 South Kilbourn Ave., Chicago, Ill., are listed in sizes from ¼ to 4 in. in diameter, by 1/16 in. increments. These seals are made in two styles, DM with flange, and DP without flange. Construction of these seals consist of a housing, diaphragm, and seal ring of special bronze. Small compression springs inserted in the housing hold the seal ring in tension with the contacting face of the ball race. To avoid torsional strain on the diaphragm, all sizes above 1 in. diameter have guide pins sliding in wells in the housing. The diaphragm is clamped to the housing and bronze seal ring. It is of special oil and waterproof fabric, and is heat-resisting up to 220 deg. F. constant temperature, 275 deg. F. intermittent. The bronze rings of the seal contact the surface of the ball or roller race, or hardened steel shaft shoulder. All bronze rings are lapped. The housing of the DP seal is made for a press fit in its retainer. This seal requires a shoulder at the front or at the rear of the seal. The DM flange type seal is made for a slip fit into its retainer. The advantage of the flange type over the press fit is that it can be readily removed for inspection.

"Mo-Max" Molybdenum High-Speed Steel

After being tested for approximately four years, several lines of molybdenum high-speed steel are appearing on the market. These steels might be classified under the general name "Mo-Max," meaning a composition in which molybdenum is the principal alloying element. From this generic title there have been developed such trade names as "MoTung," which designates the material offered by the Universal Steel Company, Bridgeville, Pa., and the Cyclops Steel Company, Titusville, Pa. The former company was active in developing such material, together with Richard Clemson of Clemson Bros., Inc., Middletown, N. Y., but later found that Joseph V. Emmons of the Cleveland Twist Drill Company had formerly been pursuing similar investigations. It was decided to operate under a patent already issued to him. Therefore, the above two steel companies are producing under license the following forms of "MoTung" molybdenum high-speed steel: hot rolled rounds, squares, flats, octagons, and special shapes; hot rolled sheets; billets, blocks, rings, disks, blanks and special forgings; cold rolled strips and sheets; cold-drawn bars and wire; centerless ground bars and rods; hardened and tempered bars and toolholder bits. Except in the case of hardened bars and bits, the steel is always furnished in the annealed condition, unless otherwise specified.

Other companies that are producing varieties of "Mo-Max" steel under similar license agreements with the Cleveland Twist Drill Company are as follows: Ludlum Steel Company, Watervliet, N. Y.; Crucible Steel Company, New York, N. Y.; Braeburn Steel Company, Braeburn, Pa.; Latrobe Steel Company, Latrobe, Pa.; Jessop Steel Company, Washington, Pa.; Halcomb Steel Company, Syracuse, N. Y.; Vulcan Crucible Steel Company, Aliquippa, Pa.

The composition of MoTung steel is as follows:

Carbon	To suit application
Molybdenum	7.50 to 8.50%
Tungsten	1.25 to 2.00%
Chromium	3.50 to 4.50%
Vanadium	0.90 to 1.50%
Manganese	0.20 to 0.40%
Silicon	0.25 to 0.50%

As compared with tungsten high-speed steel of the usual 18-4-1 analysis, the MoTung steel has the following advantages: (1) easier to machine, (2) lower temperatures for heat-treatment, (3) tougher, (4) more economical, (5) stable in price and supply, and (6) performance equal to or better than 18-4-1. The relative densities of MoTung and tungsten high-speed steel are 8.7 and 7.95, indicating that the 18-4-1 analysis is practically 10 per cent heavier than the molybdenum steel. The advantage of the material is that molybdenum is produced in this country and that sufficient tungsten can also be produced to meet the small tonnage requirements for this material. Thus, the steel is free from complications concerning the essential molybdenum and tungsten, especially during times of international stress.

MoTung steel can be used for all applications now being satisfied by tungsten high-speed steel, and is designated as a substitute for the usual type of 18-41-1 tungsten material. The steel has given good results for hack saws, slotting saws, twist drills, reamers, milling cutters, hobs, taps and chasers, cold rolling rolls, woodworking knives, and all metal and wood cutting tools of similar nature.

Heat-Treatment

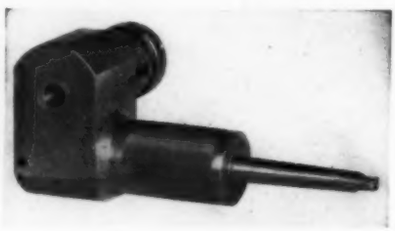
The material machines more readily than tungsten high speed steel, and cutting speeds may approach those used for ordinary carbon tool steels. It should be machine cut; it is not advisable to nick with a chisel and then break, as this procedure sets up strains, or incipient cracks. Abrasive cutting off wheels may be used for cutting small bar material. MoTung forges at lower temperatures than tungsten high-speed steel, but care must be taken to prevent the tendency for oxides of molybdenum to volatilize when heated to forging, rolling and hardening temperatures. If sufficient allowance is made for subsequent grinding operations to remove all soft skin, no particular precautions need be observed to control decarburization, other than to maintain good conditions within the heating furnaces. On the other hand, when unusually close machining tolerances are required, it may be necessary to afford some protection to the steel. Borax in various forms is effective for this purpose. Heating should be done slowly and uniformly, and the temperature should be raised gradually to 1,700 to 1,800 F. The material is then soaked to insure thorough heating, and is then brought rapidly to the forging range of 1,900 to 2,050 F. Annealing temperatures may vary from 400 to 1,600 deg. F., depending upon the degree of softness required. Material thoroughly heated at 1,550 deg. F. and then cooled slowly usually comes within a Brinell range of 200 to 228. Material may be quenched by the methods usually employed for tungsten high-speed steel. A light oil is ordinarily used, but air cooling is suitable for some tools of light section. For drawing, a temperature range of 850 to 1,080 F. is ordinarily satisfactory, but a temperature of 1,025 deg. F. is usually suitable for developing maximum cutting properties in tools hardened around 2,200 deg. F. For this temperature a Rockwell C hardness of 66.5 was obtained on a section ½ in. square.

"Handy" Brazing Flux

"Handy Flux," made by Handy & Harman, 82 Fulton St., New York, N. Y., is intended for brazing steel, monel metal, nickel, beryllium-copper, and various other ferrous and nonferrous metals and alloys. It is fluid at 1,200 F., permitting the use of brazing alloys and silver solders with low flow points. Handy Flux dissolves practically all refractory oxides rapidly, including those of chromium. It begins to fuse at 900 F., but at 1,200 F. is a thin fluid which insures thorough wetting of joint surfaces by brazing materials.

Koza Angle Tool Attachments

These right-angle tool attachments, manufactured by C. A. Koza, Inc., 464 Augustine St., Rochester, N. Y., are designed primarily for use in narrow spaces and close corners on machine repairs. Bodies are made of steel. Thrust of drill and gears is taken up by bronze bearings. By removing the screw-feed and bearing and putting in short end bearings, all tools will work in spaces the width of the body, plus the length of the drill. Chrome-nickel gears are cut integral with the shafts, heat-treated and hardened. The drill



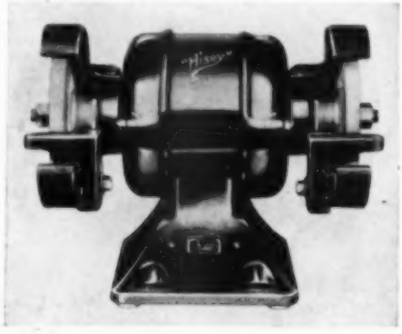
attachment shown is said to drill in left-hand corners. To drill in right-hand corners the screw-feed end bearing is removed and the position reversed, putting the screw-feed end bearing on the left side of the body and the short end bearing on the right side. All tools have a 1 in. depth of feed on screw feed. Screw feeds of any length can be made to order at extra cost. Right angle drills are made in three sizes, having capacities of ⅛ to ⅞ in.; ⅛ to ⅝ in., and ⅛ to 1½ in. They can be driven by air or electric drills, drill press, lathe or milling machine direct, or through a flexible shaft.

Master Lathe Converter

The lathe converter developed by The Master Brake & Appliance Co., Trousdale, Kansas, mounts on the lathe compound rest and has its own micrometer vertical leadscrew adjustment that provides a complete combination for milling, drilling, broaching and grinding on any work piece that may be held in a lathe chuck, faceplate or between centers. Besides using the lathe to hold the work piece, it has the advantage of all lathe feeds, speeds and the use of the compound for operations at any angle desired. A piece of metal may be milled or ground to almost any shape with this tool. The converter is adapted for use on 10 to 24 in. lathes, but may be used on some types of smaller as well as larger ones. All castings are aluminum, and all steel parts are cadmium plated. Standard ball bearings are used. It is regularly equipped with a 110 volts Robbins & Myers 60 cycle a.c. motor, although 220 a.c., 110 d.c. or 220 d.c. equipment may be furnished at a slight additional charge. Standard mills such as side, angular and end mills, hobs, gear cutters and slotters may be used. The attachment mills gears up to 12 in. in diameter. A dividing head may be furnished mounted on its own center ready to insert in the lathe spindle.

Hisey-Wolf ¼-Hp. Bench Grinder

The ¼-hp. bench or pedestal grinders, put out by the Hisey-Wolf Machine Co., Cincinnati, Ohio, are suitable for light tool and miscellaneous grinding jobs. They are equipped with ball bearings with seals excluding dust and grit. Single-phase machines have an improved split-phase motor with low starting current. A 6-in. wheel is used. Models are made for operation on 110 and 220 volts, single phase; 220 volts, 3 phase; and 115 and 230 volts, d.c. Pedestals available afford a height of 39 in. from floor to spindle.

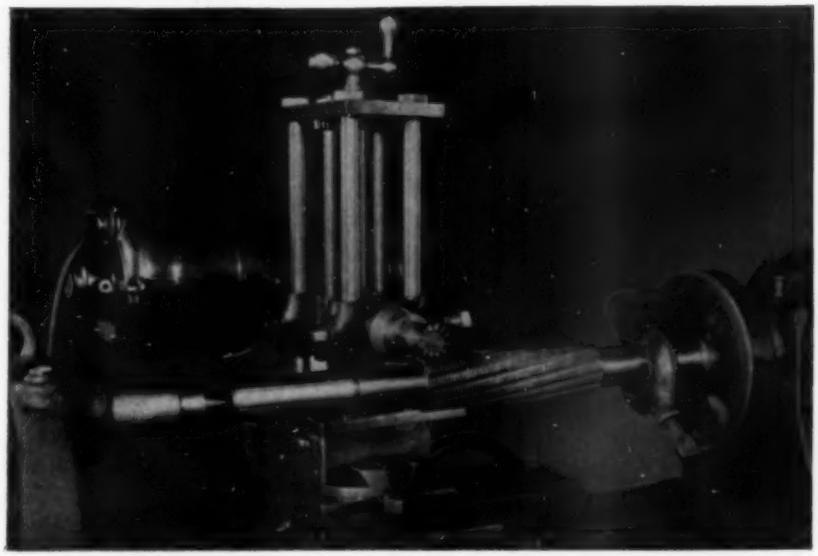


Blackhawk "Porto-Power" Portable Hydraulic Jack

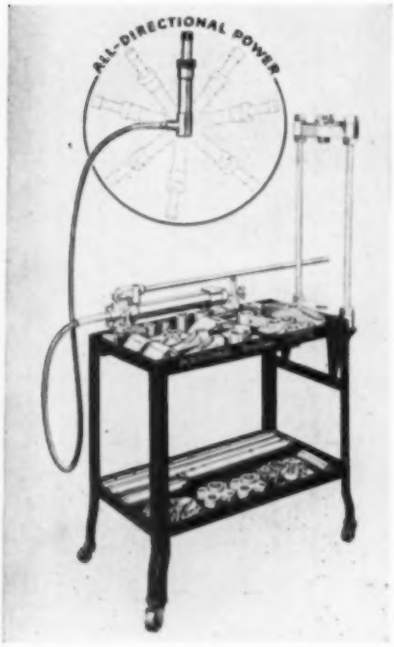
A portable hydraulic jack, known as the "Porto-Power," announced by the Blackhawk Mfg. Co., Milwaukee, Wis., makes possible many repair jobs ordinarily handled only in specialized shops. Separation of the pump and ram of the jack into two units, connected by a reinforced flexible hose, affords a hydraulic pressure equipment of great flexibility. Seven-ton power may be delivered in any direction by the ram. A group of 30 attachments is provided as standard equipment, and by easily assembled combinations with the ram, the jack is able to push, pull, spread, clamp, press and straighten under micro-controlled pressure.

The unit is completely self-contained. All equipment is carried on a portable stand which may be moved quickly to the job. The pump of the jack is mounted on one side of the stand and is removable for working away from the stand. A 6 ft. reinforced flexible hose connects the ram unit to the pump.

Mounted at one end of the portable stand is a press using the ram for power. The ram may be attached so that power may be exerted either upward or downward, depending upon requirements. Fine control of pressure is possible, the plunger of the ram being calibrated in ⅛-in. graduations. Governing the stroke of the pump enables control over movements of 0.001 in. The ram plunger travels 6⅜ in.



Milling spiral flutes in a hob with the Master Lathe Converter, making use of an attachment for gaging spirals



Obsolescence in Other Fields

IS THE extent of obselescence in metal-working equipment typical of the condition throughout industry? In other words, is there as much old equipment in the power plants, in the public utilities and in manufacturing fields other than metal-working?

The editors of *American Machinist* have always maintained that the metal-working industry is no worse, and probably not very much better, than other industries that use machinery. Unfortunately, there is not a great deal of statistical evidence to back up this contention, although such economists as Dr. Virgil Jordan, president of the National Industrial Conference Board, are in agreement with it.

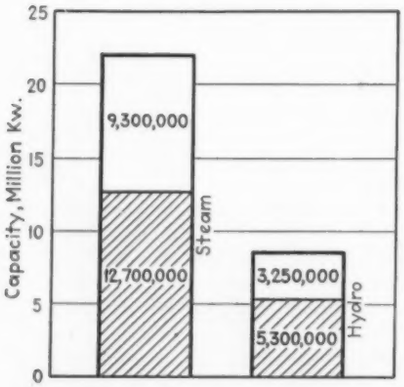
Recently, however, two surveys have been made in the power field that show results so close that they are almost coincidences. Our sister McGraw-Hill publication, "Power," surveyed the power plants of the more important units in the industrial field. The results of that survey, for the 14 divisions of the field, are indicated in the bar chart at the bottom of this page. The coincidence here lies in the overall figure—65 per cent of all power equipment is over 10 years old, identically the same figure as that developed in the *American Machinist* survey.

Furthermore, the first interim Report of the Federal Power Commission, which has just been issued, agrees exactly with "Power" on the extent of obsolescence in the steam-electric power generating equipment. Both surveys set this figure at 56 per cent. The Commission's study deals only with public utility power stations, while "Power's" covers only industrial power plants. The fact that the same obsolescence percentage obtains for both is therefore just as striking as the agreement between the *American Machinist* figures for metal-working equipment and the "Power" figures for power plant equipment.

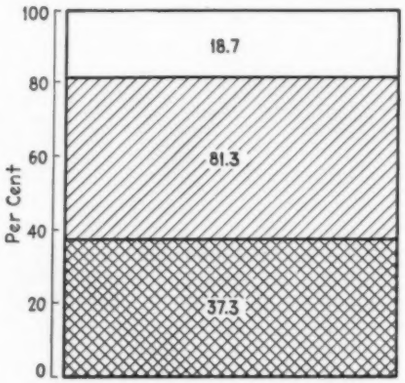
A graphic presentation of the Federal Power Commission figures for both steam- and hydro-electric machinery is shown at the left.

About the only other study of this nature which is immediately at hand is an analysis of street railway cars which was published three months ago in another McGraw-Hill business paper, "Transit Journal." The results of this study are shown graphically in the small chart below.

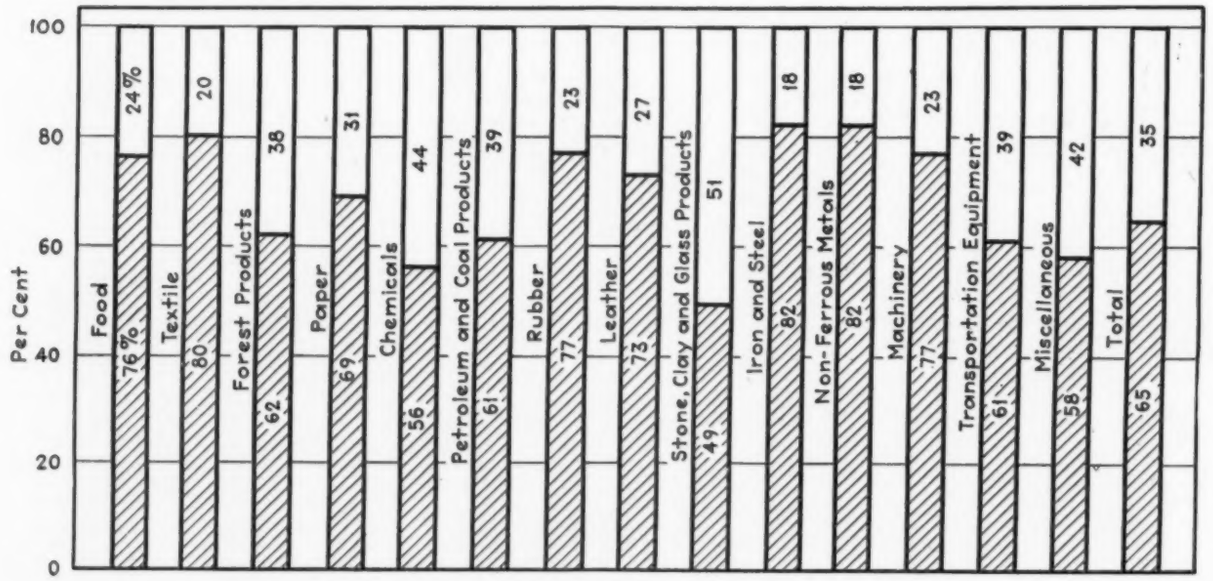
Who could ask for better markets than the replacement markets opened up by these various surveys?



12,700,000 KW. or 56 per cent of steam-electric generating equipment in public utility power stations is over 10 years old. For hydro-electric machinery the figure is 62 per cent



81.3 per cent of the street railway cars are over 10 years old, 37.3 per cent over 20 years old



Percentage of equipment in industrial power plants over 10 years old

THE ROUND TABLE

Group Training

"Have you a couple of good men you can spare us Ed? I'm getting short-handed in the erecting department."

"No, Al, we haven't. I could use a couple myself. With all the men out of work you'd think good men ought to be plentiful. But they're not."

"That isn't surprising, Ed. We haven't been training any men and the good men we had have drifted into other trades. We ought to be training a lot right now."

"Williams thinks so too, but he can't sell the idea to the big boss. He says we can't use enough boys to make it worth while."

"I've had a hunch for some time, Ed, that we ought to get all the shops in town into a group-training plan. Not just for boys but for men who might make good mechanics."

"Sort of a co-op school, Al?"

"Exactly. If you recall some of our so-called vestibule schools during the war you'll remember that we made some mighty good operators in a very short time."

"But how could we pay them Al until they began to earn money in the shops?"

"That's no problem, Ed. If a man or boy is on relief he's already provided for while he's learning. As fast as he learns and some of us can give him a job, he gets on his own and off relief. If he is still getting along without relief he'll be glad to put in the time if it will lead to a job."

"But how many want to get off relief, Al?"

"Most men, I believe, Ed. The reason so many shy at a low priced job is that it may only last a short time and then it's a hard job getting back on relief. If you tie the two together, I'm betting most of them will jump at the job."

"How about the training, Al?"

"Plenty of men who can teach will be glad of a job even at a low salary. All the shops can help out on elementary equipment. As soon as the apprentices get so they can handle a lathe or drill, most shops can use them part time anyhow to get some experience."

"It sounds a bit optimistic to me, Al. We sure need men and are going to need more. But I'm not sure your plan will work."

"Of course there are details to be worked out but I think the plan is sound, Ed. I'm going to see Williams about it tonight."

Is a group training plan feasible? Will men on relief take advantage of an opportunity to learn a trade?

Discussion

Hiring Older Men

Al is right in his intelligent placing of his men and is not likely to go wrong or to sacrifice efficiency by his method.

In our experience, we have found that there are places for men of various ages. Operations on large machines that are slow and tedious are excellently handled by men who are past 40. In our foundry we have large pit-molding jobs where the older men are employed. In our plate shop, where concentration on the various layout problems is necessary, we find that the older men serve us well. In our forge shop, we have tedious problems in heat-treating and forging that the young men become impatient with, thus leaving a place for the older men. Our pattern and carpenter shops provide work for men past 40, work that young men have not had the experience to handle efficiently. Therefore, we feel that we have definite places in our organization for men past 40, providing they are physically fit for the work.

Much valuable experience has been lost by dismissing middle-aged men without considering whether or not younger men could fill their positions acceptably. Young men must be employed to continue the productive cycle and they must be encouraged and educated by the older men.

—ARTHUR HALLIWELL,
General Iron Works Company.

Prejudice against the man past 45 years of age is merely dogmatic. In many shops, there are men past 45, who are surer of their jobs than are some of the younger men. Their employers wouldn't let them go because the service they are rendering is too valuable. When it comes to accuracy, they are often more dependable than the younger men and their perseverance will more than offset what they lack in speed.

When hiring help, the employer generally looks for young men with the view of obtaining men who have years of service ahead of them. He wants to break in men to his line of work who will stay on the job a number of years, consequently, young men look like the best bet. However, the employer is

often disappointed, for many of the younger men are ready to make changes if they have the slightest inking that there is a chance to better themselves.

The older men have learned that "A rolling stone gathers no moss," and that it is no longer easy for them to find another job. Therefore they are more dependable, hold on to their jobs and make every effort to satisfy their employers. —W. J. Owens.

Al is right in hiring older men. A normal man should grow in skill, knowledge and wisdom until he has reached the traditional three score and ten years. Chief Justice Holmes did not retire until he was nearly 90, and it was not the necessity of earning a living that caused him to hold on so long.

Employers who drop men at 45 or 50 not only do the men an injury, but they injure themselves. There are many ways in which the older men are more efficient than the younger ones. Many men like their work so well that they would continue at it even though they had a competence.

The modern outcry against employment of men after they have reached 45 is, as Al says, bunk. It is the general acceptance of this bunk that makes the Townsend plan appear so attractive to many people. The self-respecting aged man would much prefer a dose of equity to a dole. Where there is so much bunk there is a great lack of essential knowledge. Both employers and employees need to understand the problem better than they do. —W. E. Brokaw,
Executive Secretary,
The Equitist League.

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Who Buys the Micrometers?

When micrometers and other precision tools are in practically constant use by the workman, it is only fair that the shop should supply them. They are as much a part of the production equipment as are toolbits and files. However, when the workman has use for micrometers but a few times a day, both custom and his pride dictate that he should own them himself.

A plan that has worked well for us was to have the foreman periodically to inspect and check the personal micrometers of his men at the same time as the micrometers in the toolcrib are inspected. The time interval between inspections will necessarily depend upon the amount of use the micrometers have had and the precision required in the product.

—E. E. Gagnon.

Al is right in having the company furnish the micrometers for the men. How many men would check their mikes with the shop standards? How many would permit someone else check and adjust their mikes? Could the workmen get the standards from under lock and key in the toolroom to check their mikes?

The wide range of work might require mikes from 1 to 6 in. or larger. The workmen should not be required to own all the sizes necessary for the various jobs. Then if they use some of the mikes from the toolroom, why not all? This would not only guarantee the accuracy of the mikes for one job, but for all jobs. It would also guarantee accuracy and interchangeability of work. The mikes would be inspected and adjusted to the standards in the toolroom where a competent

man who specializes on that work would be on the job.

The other value of company-owned mikes and precision tools in general is the feeling of satisfaction to employees that the company furnishes and maintains the best equipment without expense to them. This has its moral in cooperation, good work and interest.

—R. C. Flohr.

A micrometer is a delicate instrument which can be ruined in a moment by an inexperienced or careless man. Whenever possible, the men should be required to own their micrometers, because even the most loyal men will treat their tools better than the company's. For this reason it is my opinion that every man who has occasion to use a 1-in. micrometer once a day or more should own one. This would include all inspectors, tool makers, and machinists. Tool makers and inspectors should also have their own micrometers in sizes up to and including 3 in., but because of varying conditions it is difficult to establish a set rule to cover all cases.

In fairness to the men, the company should provide the necessary checking and service facilities for the men's personal micrometers. This arrangement is practicable from the company's standpoint because it insures the highest degree of accuracy in the micrometers used about the plant, and it should reduce spoiled work.

—Nils H. Lou.

Finish Cuts Only

The question as to using one machine for roughing and another for finishing revolves around Ed's statement that a single machine will do both if the operator can handle it.

The quantity of work to be machined must warrant the installation of the two boring mills, whether one is used for roughing and the other for finishing, or whether each is used for both roughing and finishing. The advantages of using separate machines for roughing and finishing are that the machine for finishing is not roughly treated and therefore it retains its accuracy, and that each machine may be easily maintained in the best condition for its particular work. Bearings and slides can be adjusted to suit heavy or light duties; tool changes are less frequent; and speed and feed changes can be reduced and perhaps eliminated. Each operator has fewer dimensions to watch, and the roughing machine can perhaps be in charge of a comparatively unskilled operator. Changing the job from one machine to the other insures that clamping stresses will be relieved after roughing cuts. This is important where the work is easily distorted.

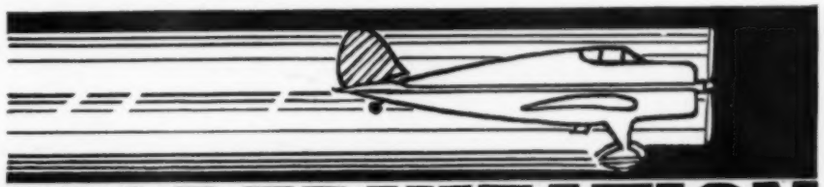
The disadvantage lies in the expense of shifting the job from one machine to the other and resetting it. As the machines in question are boring mills, the work to be handled is probably heavy.

—R. Hutcheson,
Kenton, Middlesex, England.

Tooling Up

Al's cautious policy may cause shudders in the ranks of the high-pressure efficiency experts, but it is the one that will be most likely to keep the wolf from the door. Too many people have the idea that if a direct labor saving is made it must mean a reduction in cost.

I know of one firm that has a large parent plant and several branch ones



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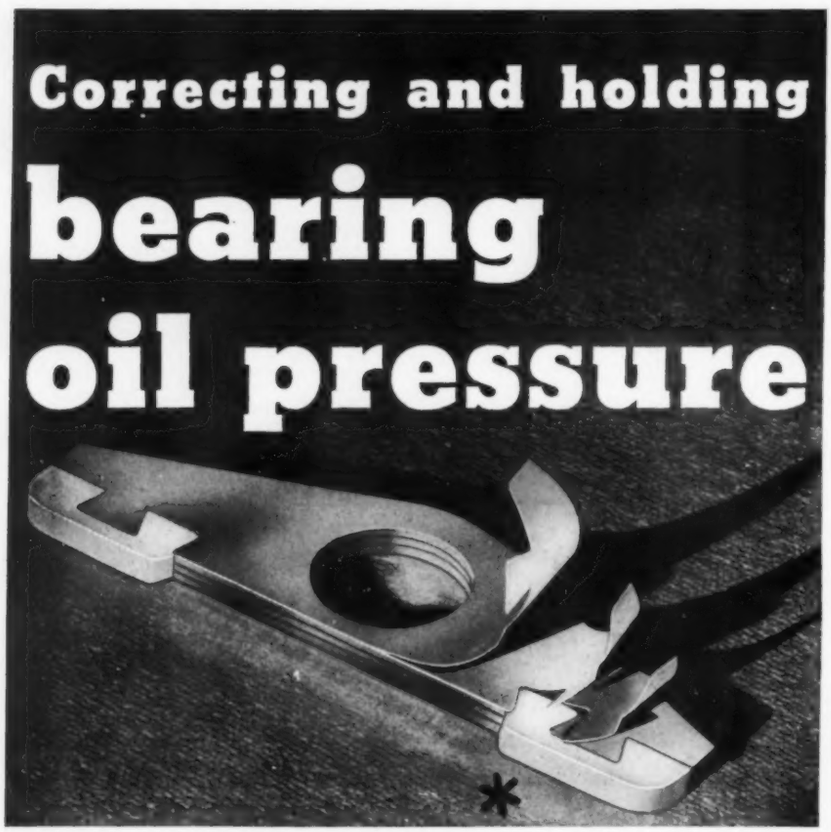
in other countries. Periodically, a survey of labor time per 100 parts is made, and if the showing of the branch plants is worse than that at headquarters there is a storm. Drawings of elaborate machines and fixtures are sent to the branch plants, and their immediate adoption is expected with a view to time cutting. It is vain for the branch plants to explain that their orders do not justify the expenditure. However, it is a settled part of the firm's policy to reduce labor costs to the minimum and to insure uniformity of work by means of jigs and fixtures.

That this policy is costly and wasteful seems obvious, but it is by no means an isolated case. Too many of the larger concerns have "efficiency" men ready to show that the foremen's methods are out of date, and how time can be cut 50 per cent by their methods. Maybe it can, but the question remains, "Is it worth it?"

—Roy Vernon Wade,
Glasgow, England.



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• TRADE • PUBLICATIONS

Dial Indicators. The L. S. Starrett Co., Athol, Mass., has issued a complete catalog covering the entire line of dial indicators recently introduced. The catalog contains 26 pages of pictures and descriptions illustrating and explaining the various indicators.

Die Heads. The Geometric Tool Co., New Haven, Conn., has had printed two booklets covering its 1935 model of D line die heads and DS type tools. Complete specifications and parts lists are included.

Flexible Shaft Equipment. N. A. Strand & Co., 5001-9 North Lincoln St., Chicago, Ill., presents its line of flexible shafts and flexible shaft machines in Bulletin No. 31. The folder illustrates 26 different models.

Grinder. The Pratt & Whitney Co., Hartford, Conn., announces publication of a circular presenting in picture form the mechanical details and improvements incorporated in its 14 in. hydraulic vertical surface grinder for 1935.

Honing Machines. Bulletin No. 135, by the Barnes Drill Co., 814-830 Chestnut St., Rockford, Ill., describes the No. 5 horizontal hydraulic honing machines. The bulletin sets forth 21 features and advantages to be found in this machine.

Mallets and Mauls. The Lignum-Vitae Woodturning Co., Inc., 96-100 Boyd Ave., Jersey City, N. J., published a leaflet on mallets and mauls made for industrial purposes. Shapes, sizes and prices are given.

Oil Seals. The Gits Bros. Mfg. Co., 1859 South Kilbourn Ave., Chicago, Ill., has printed a new general catalog, No. 50. It describes in detail oil seals, oil cups and grease cups, and automatic and centrifugal lubricating devices.

Pyrometer. The Brown Instrument Co., Wayne & Roberts Avenues, Philadelphia, Pa., has issued a pamphlet giving information on its line of potentiometer pyrometers.

Steels. The Firth-Sterling Steel Co., McKeesport, Pa., has published a folder containing the physical properties and working data on its Sterling Nirosta stainless steels.

Welder. The Ideal Electric & Mfg. Co., Mansfield, Ohio, announces a 16-page bulletin No. 910, describing in detail the Noel "Speed-Arc" welder.